Council for Scientific & Industrial Research

Food Research Institute

2008 Annual Report

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Council for Scientific and Industrial Research

Food Research Institute

The Food Research Institute (FRI) of the Council for Scientific and Industrial Research (CSIR) is an internationally recognized centre of expertise in research into problems of food processing and preservation, storage, marketing, distribution and utilization, in support of the food industry and also to advise the Government of Ghana on its food policy.

This publication is an output of the CSIR-FRI. The views expressed are solely that of the Institute.

This publication should be cited as follows:

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EXECUTIVE SUMMARY

The CSIR-Food Research Institute (FRI) is one of the thirteen affiliate institutes of the Council for Scientific and Industrial Research (CSIR). The CSIR in its changing phases of corporate augmentation has become a centre of excellence in Research and Development (R&D) by generating appropriate technologies that are responsive to demands of the private sector and socio-economic development. The mission of corporate CSIR is to generate and apply innovative technologies, which efficiently and effectively exploit S&T for socio-economic development in critical areas of agriculture, industry, health and the environment and improve scientific culture of the civil society. Technologies developed will be commercialized for private sector development in Ghana and abroad.

CSIR-Food Research Institute's vision is to be recognized, nationally and internationally, as an Institution of S&T that is playing a key role, in the transformation of the food processing industry to be internationally competitive with particular reference to product safety, quality and preservation. CSIR-FRI's mission is primarily, to conduct market oriented applied research and provides technical services and products profitably to the private sector and other stakeholders. The overall goal of the Institute is to assist in poverty alleviation through the creation of opportunities for generating and increasing incomes within the micro-, small-, medium- and large-scale food industries. The Institute further contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

CSIR-FRI presently operates under seven Divisions: Food Chemistry, Food Microbiology, Food Processing & Engineering, Nutrition & Socio-economics, Commercialization & Information, Administration, and Accounts.

In line with its objectives, the CSIR-FRI Microbiology and Chemistry Divisions continued with their task of providing analytical support to both research and industry. The Food Processing & Engineering Division continued with its functions of conducting applied research into the processing, preservation, packaging and storage of food as well as the development of new products from available raw materials. The Pilot-Scale

Production Unit of the division conducted pilot scale studies into products developed by CSIR-FRI. The Commercial and Information Division coordinates all commercial activities of the Institute. The commercialization process of the Institute continued and the following areas were the major sources of income:

- Consultancies
- Collaborative Research
- Equipment fabrication & Hire of Facilities
- Sale of Research By-Products
- Technical and Analytical Services
- Training

The total receipts for the year amounted to GH¢1,240,950 of which 93% represents government subvention for personnel emolument and administrative expenditure, 1% represents subvention for service activities (research), 6% represents internally generated funds.

The Institute now issues out certificate of accredited analytical results to clients as a result of the fifteen accredited laboratory methods of the Institute to ISO 17025, by South Africa National Accreditation Service (SANAS). The accreditation of more laboratory analytical methods is on going especially mycotoxin analytical method that has received boost from the German Government.

The year under review saw a high number of participation in local and international conferences by staff as shown in Appendix iv. In line with its mandate, the main programmes of the Institute during the year were centered on R&D activities for the solution of post-harvest and socio-economic problems of food quality and safety in the country. In this regard, the private sector Agro-processing development was a major component.

Members of FRI Management Board Old Members as at 8/8/08

1. **Prof. A. Ayensu** - Chairman
   Dep. Director-General, INSS/CSIR

2. **Dr. W. A. Plahar** - Member
   Director, Food Research Institute (FRI)

3. **Dr. E. B. Hagan** - Member
   Director, Institute for Industrial Research (IIR)

4. **Prof. Anna Lartey** - Member
   Head, Dept. of Nutrition & Food Science, Legon

5. **Mrs. Juliana Kwakyewa Dennis** - Member
   Director, WIAD, MoFA

6. **Mr. Timothy Osei** - Member
   Oduro, Adiya, Osei & Co. SEDCO House

7. **Mr. Adu Gyamfi Darkwa** - Member
   Executive Director, Ghana Standards Board

8. **Mr. Kofi Asiamah-Asiedu** - Member
   CEO, Can & Kaa Ltd

9. **Dr. Josephine Nketsiah-Tabiri** - Member
   Head, Dept. of Fd. Sci. & Radiation Processing
   BNARI-GAEC, Kwabenya, Accra

10. **Mr. Charles Gunu** - Member
    Production Manager, Fish Cannery
    GAFCO, Tema

11. **Mr. Charles Debrah-Asante** - Member
    Production Manager, Cocoa Processing Company

12. **Mrs. Agnes Osei-Yaw** - In Attendance
    Deputy-Director, Food Research Institute (FRI)

13. **Robert M. Yawson** - Secretary
    Ag. Head of Administration, FRI

Members of FRI Management Board New Members as at 8/8/08

1. **Dr. Osei Boeh- Ocansey**
   Director-General PEF - Chairman

2. Dr. (Mrs.) Rose-Emma M. Entsua –Mensah -Member
   Deputy Director-General (R&D) CSIR

3. **Dr. W. A. Plahar** - Member
   Director, Food Research Institute (FRI)

4. **Dr. E. B. Hagan** - Member
   Director, Institute for Industrial Research (IIR)

5. **Mr. Timothy Osei** - Member
   Oduro, Adiya, Osei & Co. SEDCO House

6. **Dr. Josephine Nketsiah-Tabiri** - Member
   Head, Dept. of Fd. Sci. & Radiation Processing
   BNARI-GAEC, Kwabenya, Accra

7. **Mr. Charles Debrah-Asante** - Member
   Production Manager, Cocoa Processing Company

8 .**Dr. P-N.T Johnson** - In Attendance
   Deputy-Director, Food Research Institute (FRI)

13. **Janet Aggrey- Yawson** - Secretary
   Ag. Head of Administration, FRI

Principal Officers

Chairman, Management Board ... Dr. Osei Boeh -Ocansey

Director ... ... Dr. Wisdom A. Plahar

Deputy-Director ... ... Dr. P-N.T Johnson

Heads of Division

Commercialization and Information Division ... ... Dr. P. Adu Amankwa (Mrs.)

Food Processing & Engineering Division ... ... Dr. P-N. T. Johnson

Ag. Nutrition and Socio-Economics Division... ... ... Dr. Wisdom A. Plahar

Food Microbiology Division ... ... Dr. Wisdom Amoa-Awua

Food Chemistry Division ... ... Dr. Kafui Kpodo (Mrs.)

Ag. Administration Division ... ... Janet Aggrey- Yawson

Accounts Division ... ... Mr. N. Adoboe-Mensah

Members of the Internal Management Committee

1. Dr. W. A. Plahar	- Director
2. Dr. W. A. Amoa-Awua	- Head Food Microbiology Division
3. Dr.(MrsAdu-Amankwa	- Head, Commercialisation & Info. Division
4. Dr. (Mrs.) K. Kpodo	- Head, Food Chemistry Division
5. Dr. P-N. T. Johnson	- Head, Food Proc. & Engineering Division
6. Dr. J.T. Manful	- Head, PPSU-FPED
7. Ms. J.Aggrey- Yawson	- Ag. Head of Administration
8. Dr. (Mrs). M. Ottah Atikpo	- Head, ISU-FMD/
9. Mr. Daniel Blay	- Head, EU-FPED
10. Mr. N. Adoboe-Mensah	- Head, Accounts
11. Dr. C. Tortoe	- President Local RSA
12. Mr. D. Asiedu	- Chairman, Staff Welfare
13. Mr. Ben Awotwi	- Chairman, SSA-FRI
14. Mr. M. Amoo-Gyasi	- Chairman, FRI TUC
In Attendance	
15. Ms. Mary Halm	- Quality Manager
16. Mr. S. Nketia	- Scientific Secretary

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APPENDICES

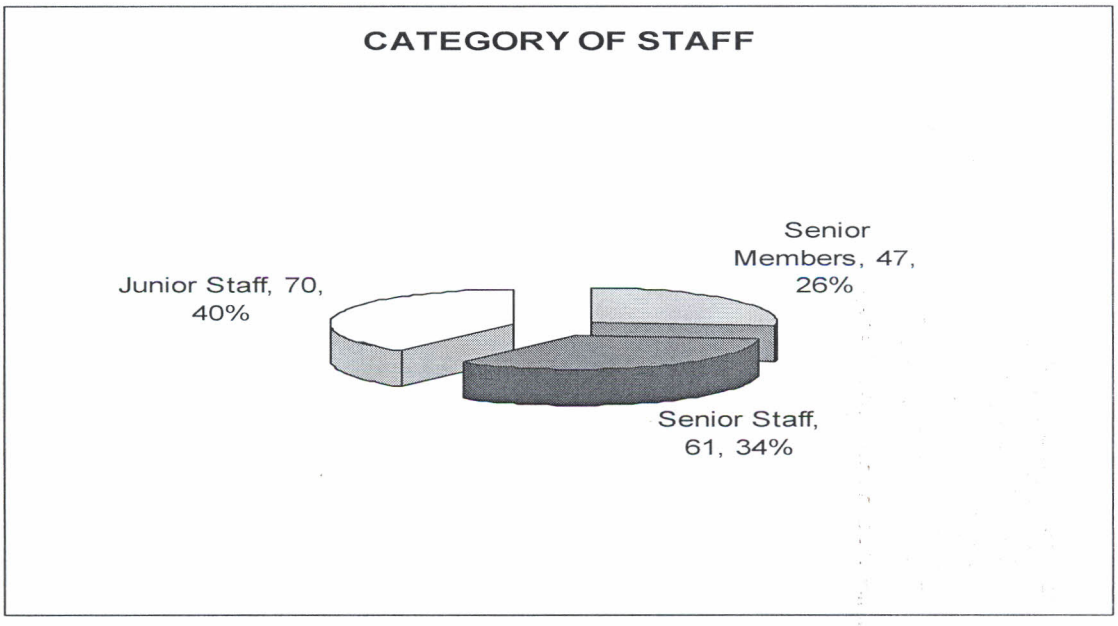
PART 1: NON – SCIENTIFIC DIVISION

1.0 ADMINISTRATION DIVISION

The Institute began the year on 7th January 2008. During the year under review the Administration Division continued to provide support services and created an enabling environment to facilitate effective and efficient performance of work by all the Divisions of the Institute.

1.1 Staff Strength

Staff strength at the end of 2008 stood at 178. This was made up of the following categories of staff.



1.2 New Appointments

The following were given appointments at the Institute during the year in review:

Philip Agaye	Security Assistant Gd. I
Foster Bosompem	Security Assistant Gd II
Francis Azure	Security Man

The following were also given temporary appointments in the year under review.

1. Ms. Dorothy Mensah — Technical Officer
2. Ms. Esther Lamptey — Stenographer Gd. I
3. Ms. Emefa.Gblade — Technical Officer
4. Mr. Francis Blankson Dadzie — Security Man

1.3 Promotions and Upgrading

During the year under review the sixteen staff members were promoted as shown in appendix VI.

1.4 Human Resource Development

The Institute continued to grant training opportunities to its staff to enable them acquire skills and knowledge needed to enhance their performance. Seven members of staff are under training while five members of staff had completed their training during the reporting period as shown in appendix V.

1.4 Resumption of Duty After study Leave

Messers. J. F. Asigbey, Theophilus Annan, Elvis Baidoo and E-C-T Tettey returned to post after successfully completing their various course of study

1.5 Transfer

Ms. Judith Dogbegah, Principal Accounting Assistant was transferred from the CSIR Head Office to the Accounts Division of the Institute in February 2008

1.6 Attachment Training

The Institute continued to offer attachment training to a number of students from the various Universities and Polytechnics in the country.

1.7 National Service

Ten (10) National Service Personnel were posted to the Institute during the period.
FMD- 4, Chemistry-4, FPED-2,

1.8 Visitors

The immediate past Director-General and the current Director-General and his Deputy paid a visit to the Institute. They were met by the entire staff members and it was a successful meeting. This took place in July 2008.

A seven member Management Board was also inaugurated in August 2008.

1.9 Retirement

Six people retired in the year under review. They are:

(i). Mr. S.O.T. Oddoye, Chief Stores Superintendent of the Accounts Division retired after 29 years service to the Institute.

(ii) Mr.Godwin Aklieh, Chief Works Superintendent of the Administration Division retired after 28 years service to the Institute

(iii) Mr. Joseph Lamptey Principal Works Superintendent of the Engineering Unit retired after 18 years service to the Institute.

(iv) Mr. J. Q. Abbey Senior Technical Assistant of the FPED also retired after 28 years service to the Institute

(v) Mr. Peter Abanamikum a Security Man retired after 20 years service to the Institute

(vi) Mr. Abraham Basata also a Security Man retired after 11 years service to the Institute.

They all retired compulsorily and we congratulate them for their dedicated service to the Institute.

1.10 Obituary

The Institute lost three members of staff in the reporting year.

They are Mr. James Yankson a Security Man, Mr. Victor Tackie a Driver and Mr. Eric Appiah a Security Man. The Director and staff of the Institute joined their family to accord them a befitting burial, may their souls rest in perfect peace.

2.0 ACCOUNTS DIVISION

2.1 Introduction

The Finance and Accounts Division is responsible for maintaining effective and efficient accounting and financial systems. The Division ensures that, the institute is in compliance with the CSIR stores and financial regulations and other statutory legislations. The Division supports all the other Divisions to carry out their financial obligations for the smooth running of the Institute. It prepares the financial statement, annual budgets, and administers funds from donors. There are two main sections of the Division, these are the main finance and accounts and the Stores sections. The main section is made up of the ledger, the payroll, procurement and the cash sections.

2.2 Staff Strength and Movement

As at the end of the year 2008, the staff strength of the Division was eleven (11). The main section had seven (7) members of staff. They are: Mr. Adoboe Mensah, Mr. Tutu Aikins, Mr. Ken Aidoo, Mr. Christain Amegah, Mr. J. K. Larbi, Ms. Mabel Aryee, and Ms. Judith Dogbegah, The stores section was made up of four (4) staff members who were: Mr. John Mintah Nakotey, Mr. George Ohene Gyamfi, Mr. James Cromwell and Mrs. Angela Addy.

2.3 Major Activities

The major activities of the Division include;

- Preparation of Financial Statements for the Institute,
- Preparation of financial report on Government of Ghana (GoG) fund and disbursements
- Ensure that funds from donors comply with programmed budgets
- Ensure compliance with Taxation and other financial reporting procedures
- Manage the payroll function ensuring efficient systems, process and controls
- Oversee the external Audit, review and analyze reports and give recommendations.
- Preparation of quarterly financial returns to CSIR Secretariat.

The Stores section receives and issues items procured for effective running of the Institute. These items include chemicals, media, stationery, etc.

`2.4 Accounting System

The accounting system of the Institute during the year under review was assessed to be in-line with the stores and financial regulations of the CSIR. The system established is satisfactory for capturing financial data i.e. revenue, expenditure, assets and liabilities. Segregation of duties was found to be adequate and well spelt out with different staff responsible for different functions e.g. Pay roll, final accounts, cash receipts and payments, procurement etc.

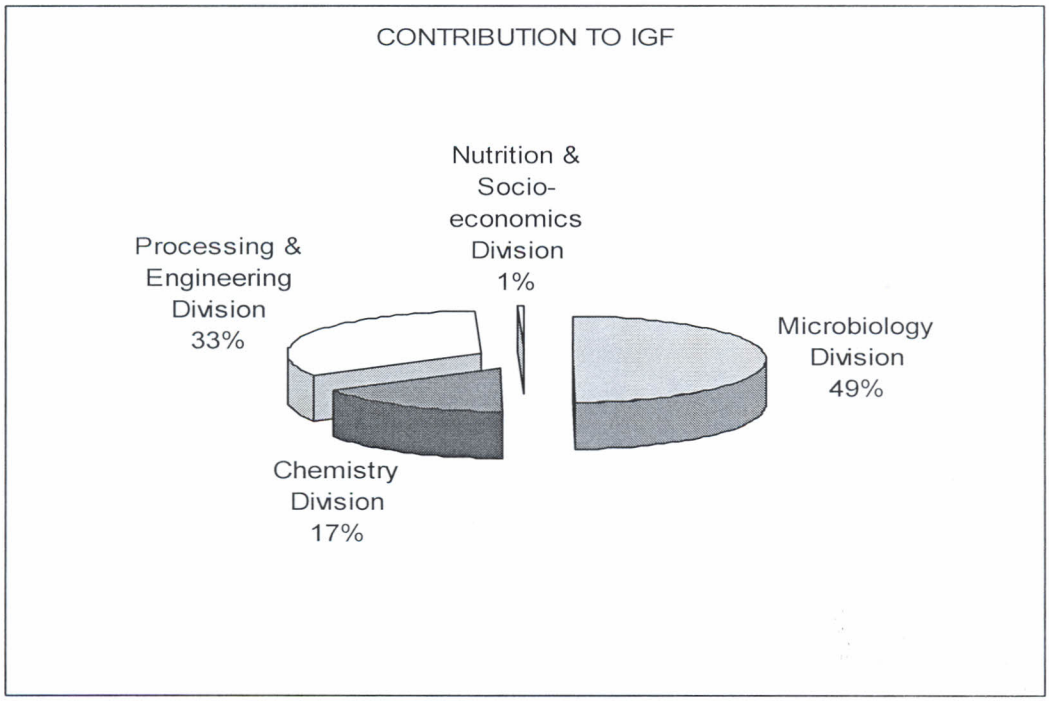
2.5 Financial Overview

Items	FRI Budgeted GH¢	GOG Approved GH¢	Released GH¢	FRI Actual GH¢	Shortfall GH¢
Personnel Emoluments	1,750,435	978,747	1,114,033	1,303,998	(189,965)
Admin. Expenses	331,600	327,100	39,388	144,065	(104,177)
Service Activities	96,000	26,898	10,223	6,250	3970
Investment Activities	50,000	17,500	-	-	
IGF			76,806		
TOTAL	**2,228,035**	**1,350,287**	**1,240,950**	**1,454,313**	**(298115)**

The total receipts for the year amounted to GH¢1,240,950 of which 93% represents government subvention for personnel emolument and administrative expenditure, 1% represents subvention for service activities (research), 6% represents internally generated funds.

2.6 FRI INTERNALLY GENERATED INCOME

The total internally generated income was GH¢282,578 for the year under review. Out of this amount Microbiology and Processing & Engineering generated 80% with chemistry and other units generating the remaining 20%.



The total related expenses was **GH¢205,712**, yielding a net income of **GH¢76,806** which is 27% of the total income and 509% of the last year's of figure of **GH¢12,613**.

The income for last year went up by 63% of that 2007 with total expenses going up to 28% of the 2007 figure.

2.6 Constraints

i) Lack of Funds to run the Institute activities.

ii) Delay in release of Government subventions to meet personnel emoluments administrative activities and research activities.

iii) The government's pay roll system – IPPD 2 is yet to take off within the CSIR.

iv) Delay in accounting for imprest taken by staff – **GH¢19,655** (2007), **GH¢9,008** (2008)

2.7 Plan activities for 2008

The following activities for the division have been plan for the year 2008,

- Preparation of 2009 annual budget estimates
- Preparation and audit of 2008 final accounts
- Reconciliation of bank accounts debtor, and imprest accounts
- Submission of quarterly returns to CSIR head office.

3.0 COMMERCIALISATION AND INFORMATION DIVISION

3.1 Introduction

The basic task of the Commercial and Information Division (CID) is to coordinate the commercial activities of all the other Divisions of the Institute in order to generate income for the Institute. The Division has three Units namely the Public Relations Unit, Client Services Unit and Library and Publications Unit.

3.2 Staff Strength

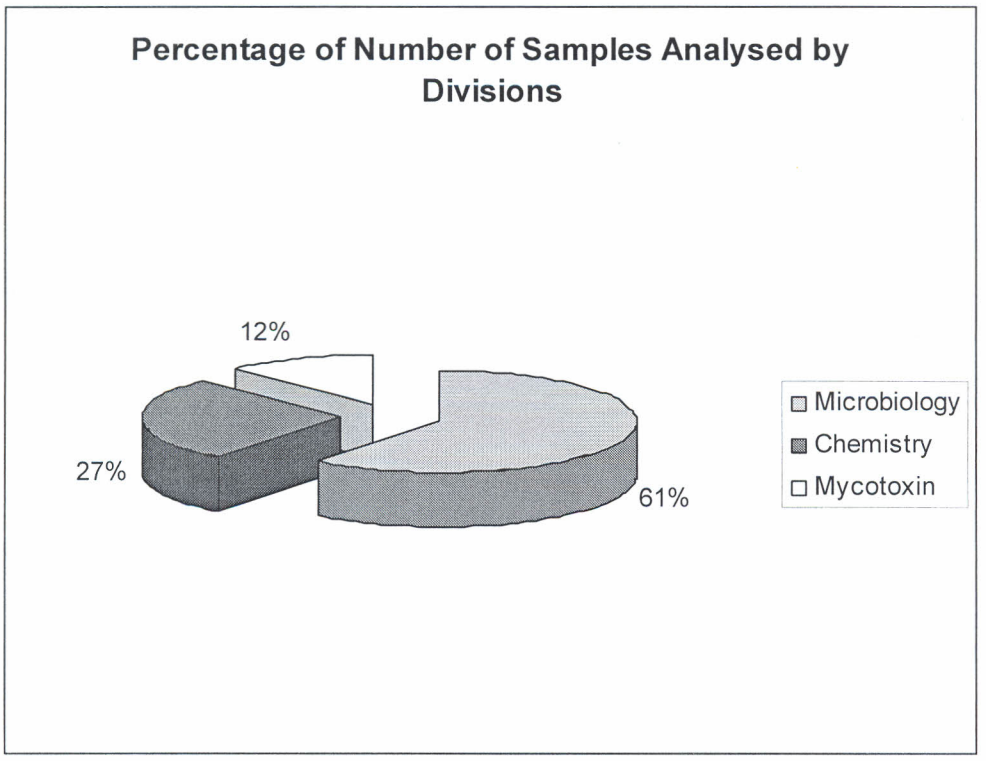
The staff strength of the Division stood at 21 at the end of the year. It is made up of Dr. (Mrs.) Pearl Adu-Amankwa, Head of Division, Mr. Kwabena Bugyei, Assist Mr. Augustine Andoh, Chief Technical Officer (C.T.O.), Public Relations, Mr. Ben Awotwi, C.T.O., Marketing, Mr. Raphael Kavi, Jnr. Assistant Librarian, Stephen Atta-Sonno, Library Assistant Gd. II, Mr. Philip Baidoo, Senior Accounting Assistant, Ms Joana Dzikunu, Senior Administration Assistant, Ms. Mary Assimah, Administration Assistant and Mr. Gariba Alimiyao, Driver Inspector.

3.3 Commercialization Activities

The main activities carried out in 2008 include collection of samples for analysis, transfer of technology, hiring of Institute's facilities, and organization of training programs and sale of research by-products and compilation of client database

3.4 Income Generation

The net Internally Generated Income (IGF) of the Institute amounted to about **GH¢191.00**. Overall about 1,578 Microbiology, Chemistry and Mycotoxin samples were tested.



Major clients for Microbiology were the Pioneer Food Cannery, Cadbury, Promasidor Gh. Ltd, Aquafresh, Healthilife Beverages, Burger Food Industries, and Aviation Handling Service.

Major clients for Chemistry were Ghana Inspections Ltd. and WAMCO. Ghana Standards Board, Burger Food Industries, Ghana Inspections Ltd were the main clients for mycotoxin.

Major clients for Mycotoxin were Ghana Standards Board, Burger Food Industries, Ghana Inspections Ltd.

3.5 Public Relations activities

a) FRI Media Exposure in 2008

Media relations were as usual excellent. The media was regularly monitored. There were no adverse comments in the media networks.

Several articles were also published in the Daily Graphic. Some of these were "Consume More Cocoa" by Dr. L.D. Abbey, Dr. (Mrs) P Adu-Amankwa and Augustine Andoh,

"Accreditation towards quality products", "CSIR Chalks up 50" and "New Nutritional Interventions in Ghana" that were written by Augustine Andoh.

The PRO was also the secretary of the Press conference Committee set up by the Director to plan the press conference to announce the accreditation of 15 laboratory methods to ISO 17025. A press release was prepared to help the press in reporting the event. A new story was also posted on the CSIR website.

b) Exhibitions

The PR Officer, in collaboration with the Scientific Secretary, undertook photographic project of FRI laboratories and prepared exhibitions material for the CSIR@50 Exhibition at the CSIR Secretariat. Eight new banners posters on institute activities were made. New colour brochures on the (achievements, laboratories and profile of the institute) were prepared and printed.

c) Meetings

The PRO and Scientific Secretary attended four meeting of the CSIR Committee and PRO's and Scientific Secretaries

d) Visitors

The Institute received groups of students: 60 students were from the University of Cape Coast (UCC) branch of the Laboratory Technology Students Association of Ghana and Students of the Faculty of Engineering Science of the University of Ghana and the Berea Social Foundation.

3.6 Database of Clients

There were many clients who patronized the Institutes' analytical services. Apart from educational institutions and individuals, there are some major clients who patronized the analytical services of the institute as shown in the tables below.

MICROBIOLOGY

Customer	Frequency	No. of Samples
PFC	21	275
Cadbury,	26	179
Promasidor Gh. Ltd	8	64
WAMCO	2	14
Aquafresh	3	60
Healthilife Beverages	9	36
Burger Food Industries	8	8
Aviation Handling Service	10	20

CHEMISTRY

Customer	Frequency	No. of Samples
Ghana Inspections Ltd.	20	32
WAMCO	6	43

MYCOTOXIN

Customer	Frequency	No. of Samples
Ghana Standards Board		56
Burger Food Industries		8
Ghana Inspections Ltd.		11

3.7 Library report for 2008

The Food Research Institute's library is one of the most important libraries that provides and disseminates information in the field of food science and technology, nutrition, food microbiology, aflatoxins and mycotoxins, agricultural economics and food engineering in the country.

The library has about four thousand books (4000) and over two hundred (200) back issues of scientific journals in its stock. The library also currently has a subscription for ten scientific journals.

The clientele of the library has extended beyond the Institute's research and technical staff to include students from the various universities and polytechnics in Ghana. The library is also patronized by lecturers, farmers, Industrialists, Journalist, Civil servants and Public servants, Consultants and many others.

A total of one hundred and twenty-five persons (125) used the library during the period under review. On the whole, the clientele's acknowledge that the information provided was useful but there was the need to improve the current stock.

The library continued to enjoy the availability of Internet Connectivity making it possible for the institute's research scientists and technical staff to browse the net and access their electronic mails and access full text articles for their work.

a) Information Request

Information sought for during the period under review included publications on so many food items; maize, sorghum, cowpea, cashew nut, palm kernel oil, cassava soybean, potato, coconut oil. Information on processing of various food products, their shelf life studies and also HACCP in food processing were given to the public; coconut juice processing, fante kenkey processing processing of orange fruits, fish smoking, the production of dawadawa using legumes, oil extraction and extrusion of cassava products.

Information on food analysis and food balance sheet for Ghana concerning post harvest quality of food products and osmotic dehydration method for preserving food plantain, post harvest handling of vegetables, mushroom cultivation, grass cutter rearing, plantain and banana were released to the public.

b) Referrals

The library directed some clientele's to MOFA library, CSIR-INSTI, and College of Agriculture and Consumer Science library (Univ. of Ghana) during the period under review.

c) Usefulness of information provided

During the period under review the users noted that the information provided was useful but remarked that there was the need to replenish the stock of the library with up to date publication and provision of e-resources. Users who visited the library personally to source for information had various information materials provided for their perusal. These included books and journal articles that were acquired from CTA/SDI Service and also others made use of the TEEAL Collection and Ghagri database.

In the area of publicity of services, the research scientists and technical staff were informed by word of mouth of certain information resources available in the library. The library also during the period under review sent e-mails to research scientists to inform them of journal articles and publications available in the library.

The users of the library during the period under review recommended the acquisition of current publications to replenish the outdated stock and the acquisition of computers to enable the library operate an internet café

PART II: SCIENTIFIC DIVISION

4.0 FOOD NUTRITION AND SOCIO-ECONOMICS DIVISION

4.1 Introduction

The Food, Nutrition and Socio-economics Division (FNSED) conducts studies into consumer demands and the utilization of food. The general activities of the Food Nutrition and Socio-economic Division during the year under review can be summarized as follows: Nutritional surveys, Baby food formulations and supply, Consultation services, Exhibition of divisional formulated products, Recipe development and documentation and Training of clients in product development. Currently, the division is also investigating the micronutrient and phytochemical contents of indigenous green leafy vegetables. In addition, the Division conducts surveys and feasibility studies into the economic viability and socio-economic impacts of on-going projects in the Institute. The division consists of the socioeconomics and the nutrition units. The latter handles community and human nutrition studies and runs a test kitchen which conducts sensory tests on products developed by the CSIR-FRI and industry.

4.2 Staff Strength

The total staff strength as at December, 2008 stood at 11 i.e. 7 Research grade staff and 4 Technical grade staff. The staff comprised one Principal Research Scientist, three Research Scientists, three Assistant Research Scientists, one chief Technical Officer, two Senior Technical Assistants and one Technical Assistant Grade Two.

4.3 Study Leave

Two members of the division were on study leave during the period under review.

Ms. Bernice Kudjawu	MSc. Purdue University/University of Ghana
Mrs. Ivy Yawson	MSc. Univ. of Minnesota/Univ. of Ghana

4.4 Internship

The Division supported the training of the thirty year students from KNUST, Food Science and Technology Department who were under internship for two months.

4.5 National Service

No service personnel were posted to the division in the year 2008

4.6 Student Projects

- Moringa-fortified fruit juices
- Moringa-fortified baby food formulation
- Sensory evaluation and analysis of Wagashi.
- Two treatments of celery crackers. Sensory evaluation and analysis of same.
- Sensory evaluation and analysis of 13 formulations of Moringa beverage

4.7 Consultancy Services

- CSIR-FRI/CSIR-CRI Plantain Project:

  Food product development and sensory evaluation

  a. Plantain flour
  b. Plantain chips
  c. *Tatale* and *Kaklo*
- Free advisory services to individuals in the Moringa processing industry and the Moringa Association of Ghana.

4.8 Training

- Training of a client in soy products processing
- A *Moringa olefiera* leaf processing training workshop was organised for processors in August.
- Training of some staff of CSIR-FRI in accurate sensory attribute identification, sensory procedure and terminology using rice and fruit juices

4.9 Projects

- Recipe development for *Moringa olefiera*. Trials included moringa candies, and incorporation of moringa in polo biscuits. Project is on-going.
- Establishing the best drying methods for maximum nutrient retention, and shelf – life stability for moringa leaf powder production.

5.0 FOOD CHEMISTRY DIVISION ANNUAL REPORT

5.1 Introduction

The Chemistry Division comprises two units namely the Food Toxicology Unit and the Industrial Services Unit. The Division conducts applied research relating to chemical contaminants (mycotoxins) in foods and feeds as well as food flavour (aroma) analyses. A major function of the Division is the support it gives to the commercialisation activities of the Institute by offering analytical services to Industry, local and International students, as well as other clients.

5.2 Staff Strength and Movements

The Division has staff strength of 16 as follows:

1 Senior Research Scientist
1 Research Scientist
1 Assistant Research Scientist
1 Assistant Scientific Officer
2 Principal Technologists
2 Senior Technologists
1 Technologist
1 Senior Technical Officer
5 Technical Officers
1 Senior Technical Assistant

The following staff movements occurred during the year:

(i) Ms. Dorothy Mensah was offered appointment to the Division during the year under review whilst Ms Emefa Gblende was transferred from the Microbiology Division to the Chemistry Division.

(ii) Mr Charles Diako continued with his MPhil Programme at the Food Science Department of the University of Ghana.

(iii) Mr Essel commenced studies at the University of Development Studies leading to a BSc Degree in Chemistry

(iv) Ms Mercy Fianu started studies at the University of Cape Coast leading to a BSc Degree in Laboratory Technology

5.3 Analytical Services

During the year under review, the Division offered analytical services to several companies, establishments and individuals. A total of 428 samples were received by the Industrial Services Unit for analyses. This number represents a 12% increase over the 382 samples received in 2007.

The samples analysed included maize, rice, sorghum, cashew nuts, soybean and soybean products, wheat flour, milk and milk products, spices, vegetable oils, animal feed, beans cocoa powder, cocoa liquor, Burger Peanut snacks, Snappy Peanut snacks, beans, honey, alcoholic beverages, fruit drinks, edible oils, tuna among several others. The clients included Ghana Inspections Ltd., Ghana Standards Board, Promasidor Ghana Ltd., Ghana China foods, Macbells company Ltd., Mamps Services, Afrotropic Cocoa Processing, Ghana Nuts, Divine Shitto, Myroc Food Processing, Tata Beverages, Agricare Ltd., Saagar Impex (Gh) Ltd., Songhor Salt Project, Ghana Feeds Mill, Ghana Feed Mills, Food and Drugs Board, Nutrition Ventures Ningo Salt Ltd., Yedent Agro Processing Ventures Ltd., among others. Analysis of the 428 samples generated a gross income of Thirty Four Thousand, Seven Hundred and Fourteen Ghana Cedis, Forty Five pesewas (GH¢ 34,714.45)

During the year, the Toxicology Unit received a total of 192 samples for aflatoxin analysis as against 150 samples for the year 2007. This represents an increase of 28% over the previous year. The samples consisted of Wheat Soy Blend, Corn Soy Blend, Maisolet Soya Blend, Banku Mix, Cocoa, Hausa Koko Flour, Burger peanut snacks, groundnut kernels and paste, cassava chips, gari, maize grits, bean flour, rice, and animal feed among others. The major clients included Ghana Standards Board, Burger Food Industries, Elsa Foods, Comas Foods, Yedent Agro Processing Ventures Ltd., GAFCO, Ghana Inspections Ltd., Nkulenu Industries, Guiness Ghana Breweries Ltd., Ghana Nuts Ltd., C&S Foods Ghana Ltd. Agricare Ltd., among others. Total charges for the 192

samples amounted to Twenty Three Thousand, Four Hundred and Thirty Six Ghana Cedis (GH¢ 23,436).

The gross total for the two Units of the Chemistry Division was therefore Fifty Eight Thousand, One Hundred and Fifty Ghana Cedis, Forty Five Ghana Pesewas (GH¢ 58,150. 45). This amount represents an increase of GH¢ 25,664.20 (79%) over the gross income for 2007.

Summary of gross income generated in 2008 by Chemistry Division

Quarter	Industrial Services Unit		Toxicology Unit	
	No of Samples analysed	Gross Income GH¢	No of Samples analysed	Gross Income
1st	90	8,032.80	49	6,192
2nd	87	8,179.40	53	5,544
3rd	109	10,257.25	35	4,200
4th	142	8,245.00	55	7,500
TOTAL	**428**	**34,714.45**	**192**	**23,436**

5.4 Practical Training and Industrial Attachment

(i) Two students, Nasara Abubakar and Rudolf Onipayede both from Accra Polytechnic were on Practical Attachment in the Division from 18th August – 26th September 2008. Enoch Acheampong (Accra Polytechnic) was also on attachment with the division from 11th to 26th September 2008.

(ii) During the year the following also benefited from Industrial Attachment/training in the Division:

Juliet Amuzu (UDS) from 17th June - 17th August 2008

Lawrence Okai Boafo (KNUST) from 2nd June – 6th August 2008
Araba Incoom (KNUST) from 16th June – 21st July 2008
Emmanuel Addai (UCC) from 3rd June - 30th July 2008
Selorm Okai-Adjei (UCC) from 7th July – 31st July 2008
Charles Commey (UCC) from 1st July – 31st July 2008.

(iii) One PhD student (Mr Paul Houssou) from Benin was here to complete his analytical work on mycotoxins from 30th June to 19th September 2008.

(iv) Two MPhil. Students (Akosua Addo and Mark Addo) from the Botany Department of the University of Ghana also conducted part of their studies in the Mycotoxin Laboratory from 11th to 27th March 2008.

5.5 National Service Personnel

(i) During the year two National Service personnel (William Arko and Isaac Mensah-Boansi) who started their service with the Division in October 2007 completed in July 2008.

(ii) Three new Service personnel were assigned to the Division in October 2008. They are Selali Dotse, Jemima Ofori and Francis Neequaye Kotei. They will be with the Division till August 2009.

5.6 Accreditation of Chemistry Laboratories

5.6.1 Internal Audits

In compliance with the Accreditation Quality Manual, two internal Audits were conducted during the year under review. These were held in March and October 2008.

5.6.2 Proficiency Tests

By the Quality Manual, the methods in use have to be subjected to proficiency testing once every two years. The Division placed the orders for the test materials at the end of 2008 in preparation for the tests in 2009. The Testing Body used was the Food Analysis

Performance Assessment Scheme (FAPAS) of the Central Science Laboratory of the U.K.

5.6.3 EU External Audit of Aflatoxin Laboratory

As a follow-up to the EU Audit of the Mycotoxin Laboratory held in September 2007, a SARAF Mycotoxin training programme was conducted for staff of the Chemistry Division from 19th to 30th May 2008 at the Food Research Institute.

5.6.4 Training

The Staff of The Food Chemistry Division were involved in Internship Programme for thirty (30) 3rd Year students from the Food Science and Technology Department of KNUST from 1st to 22nd February 2008. Staff of the Division trained the students on Chemical analysis of foods and demonstrated the use of specific analytical equipment in the Chemistry Laboratories.

5.7 Divisional Meetings.

The Division held several formal and informal Meetings during the year. Most of these Meetings were used to discuss accreditation matters and other issues pertaining to the progress of the Division.

6.0 PROCESSING AND ENGINEERING DIVISION

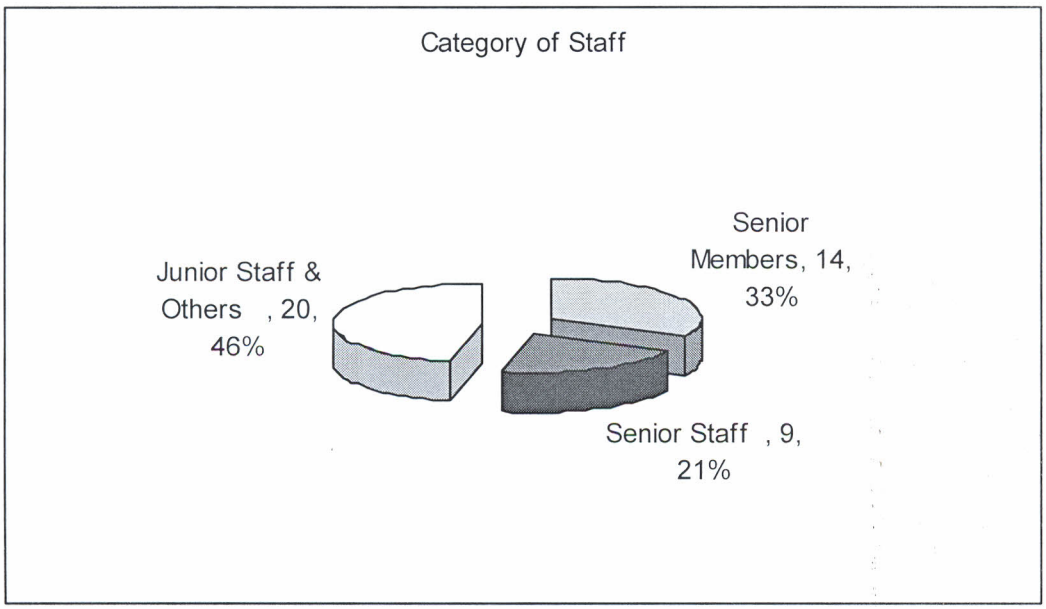
6.1 Introduction

The Food Processing and Engineering Division is the largest division in the Food Research Institute. Its main role is to undertake research and development activities in food processing to add value staple food crops. It helps many clients wanting to start up food processing centres. It also offers a number of processing services to clients.

6.2 Staff Situation & Movements

6.2.1 Staff Position

The number of staff at the FPED, during the year under review, totaled 47; made of:



6.2.2 Study Leave

One senior member, Mr. E-C. Tettey, continued his PhD course at the Department of Nutrition and Food Science, University of Ghana. Two other technologists, Messrs. Appolonius Nyarko and Emmanuel Alorsey were offered study leaves to pursue degree courses at the University of Cape Coast and Kwame Nkrumah University of Science and Technology in September.

6.2.3 *Travels & Other Activities of Senior Members*

Dr. J.T. Manful traveled to the International Rice Research Institute in the Philippines in November, 2008 to begin a project titled "*Clearing Old hurdles with New Science: Improving Rice Grain Quality*". This project was organized by the International Network for Quality Rice in Manila, Philippines.

6.2.4 *National Service Personnel*

Two national service personnel were attached to the Division during the year.

6.2.5 *Student on Internship*

Fifty –two third year students of the Food Science and Technology Department of the Kwame Nkrumah University of Science and Technology were attached to the Division for three weeks undertake their internship.

6.3 The Units & Consultancy Services of the Division

6.3.1 *The Pilot-Scale Production Unit (PSPU)*

During the year under review, commercial activities in the PSPU continued with renewed vigour. The major activity carried continued to the dehydration and processing of various food products received from clients both externally and internally (researchers and projects of the FRI). There were however other clients who brought in a variety of products for roasting and milling into flours and pastes. Some of the major clients of the Unit during 2008 were Tayaako Co. Ltd, Plaspack Industries and MV Foods.

Major Challenges

- The old Rolls Royce dryer needs rehabilitation or replacement.
- The water storage facilities in the Unit are in a poor state of disrepair and urgent rehabilitation.
- The floors and walls of the main processing hall also need polishing and painting respectively.

- Measures need to be put in place to control rodents and spiders in the processing hall.

6.3.2 The Engineering Unit (E.U)

The 2008 year saw the Unit continuing with its routine maintenance of processing and analytical machines and equipment of all divisions of the Institute. Air conditioners in all offices and laboratories were routinely maintained. Power out lights in offices and laboratories as well as street lights was also replaced.

Major fabrication jobs that were undertaken by the Unit at the request of a number of Institute's clients include the following:

- Construction, delivery and installation at Ashongman of a 102-tray dryer for KASDAR Ltd. This work was expanded to cover after sales maintenance of the dryer for a one year period.
- Modification of a gas oven into an electric dryer for WAD AFRICAN FOODS LTD at GICEL, near Weija, Accra.
- Construction of a stainless steel hammer mill for REV. NUNOO OF DANSOMAN.
- Design and construction of two stainless steel horizontal mixers for WORLD FOOD PROGRAM (WFP).
- Fabrication and installation of cassava grater, screw press and a centrifugal flour sifter for CASSACOXA CO. LTD.
- Fabrication of a hammer mill for ZINIE GROUP OF COMPANIES.
- Fabrication of milk mixture for MAPOUKA CO. LTD.

A six-tier scaffold was constructed for use at the new building and elsewhere to enable technicians reach higher heights to repair and maintain equipment. The unit contributed immensely in the Institute's final preparation towards the accreditation process. The unit installed six street lights on top of the new building to improve security. A change-over switch was also installed at Bungalow 21 at the Broz Tito Avenue campus.

A vacuum pump at Toxiocology laboratory was also rehabilitated.

6.3.3 The Root and Tuber Products Development Unit

A total of 72.64 tons of fresh cassava was processed during the year. The main products were Agbelima (15.45tons), kokonte (1.14 tons), gari (0.05 tons) and starch (0.58 tons).

6.4 Divisional Meetings

During the year under review, the division held two meetings. One of such meeting was devoted to senior members only in the Division. During such meetings, a number of issues were discussed.

6.5 Training Workshops

During the year under review, a number of customized training workshops were organized by the Division for a number of clients. These mainly in fruit juice production.

6.6 Research Projects in the Division

6.6.1 CSIR-FRI/ GTZ/ / MoAP Project

During the year under review, the CSIR-FRI/GTZ/MOAP Project began in June 2008. This project aimed at designing drying equipment for processing of fruits into high quality dried products.

6.6.2 CSIR-FRI/ British Council/ Nkulenu Industries Limited African Knowledge Transfer Partnership (AKTP) Project

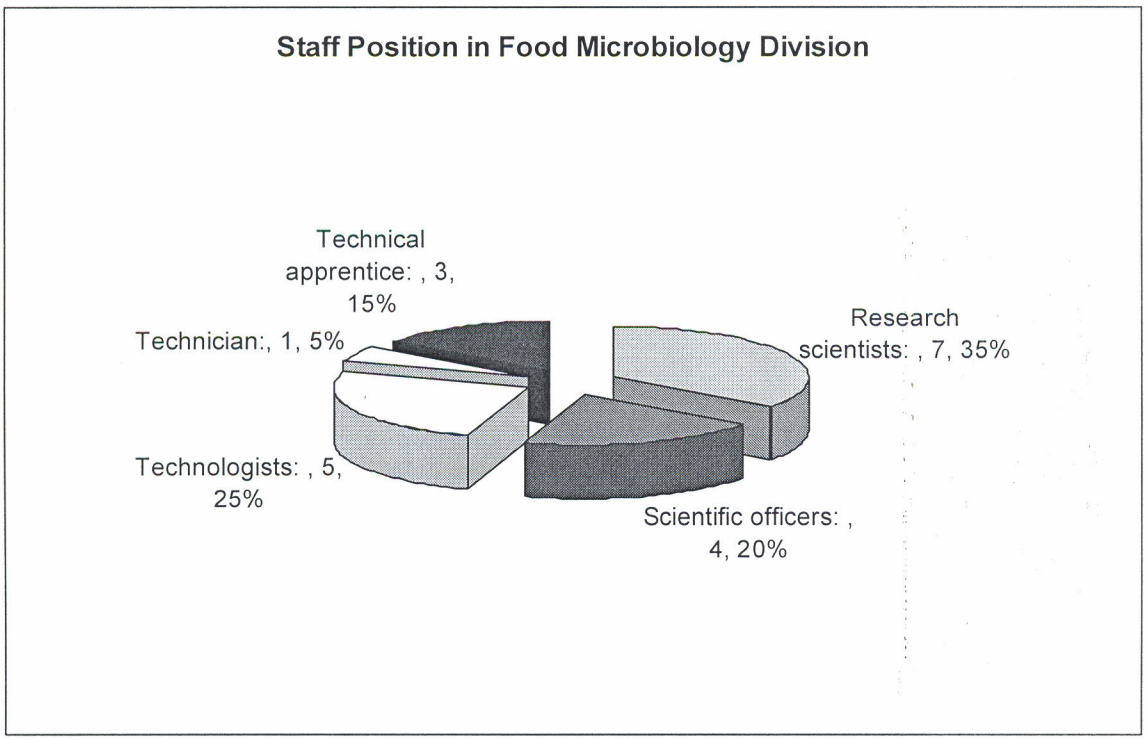
During the year under review, a project to improve the fruit products of Nkulenu Industries Limited which are already on the market was initiated with funding from the British Council. The aim was to enhance their competitiveness of the products. The company produces orange marmalade, pineapple jam and orange squash for sale on the local market. Crystallization and over-sweetness are the problems related to the orange marmalade and the pineapple jam. Separation occurs in the orange squash.

7.0 FOOD MICROBIOLOGY DIVISION

7.1 Introduction

The Food Microbiology Division is made up of the Industrial Service Unit (ISU) and the Mushroom Unit (MU). The ISU conducts important microbiology analytical services to food industries in Ghana and Food exporters. The MU serves as biotechnology center for mushroom research and development. It host the national mushroom spawn bank that is constantly being updated and reengineered to serve the good number of mushroom growers in the sub region. The Food Microbiology Divisions' main role is to undertake research and development activities in food safety and quality assurance to staple foods in Ghana.

7.2 Personnel



Resignation: Mr Fred Sarpong (Assistant Scientific Officer)

Transfer: Ms Bernice Kudjawu transferred from Socio-Economics & Nutrition Division to Food Microbiology Division after her completion of an MSc degree in Food Science with specialization in Food Microbiology.

7.3 Activities Carried Out in the Division

The main activities carried out by the Food Microbiology Division in 2007 were:

(i) Analytical services to clients.
(ii) Mushroom spawn and compost bags production and sales.
(iii) Research activities.

7.4 The Industrial Services Unit: Analytical services carried for customers

The Food Microbiology Division continued with its routine analytical services carried out for clients through the CID. A total 1943 samples were analyzed for clients involving a total number of 4,218 individual analyses (Figs 1 -3). The most important clients during the year were Cadbury Ghana Ltd. and Pioneer Food Cannery.

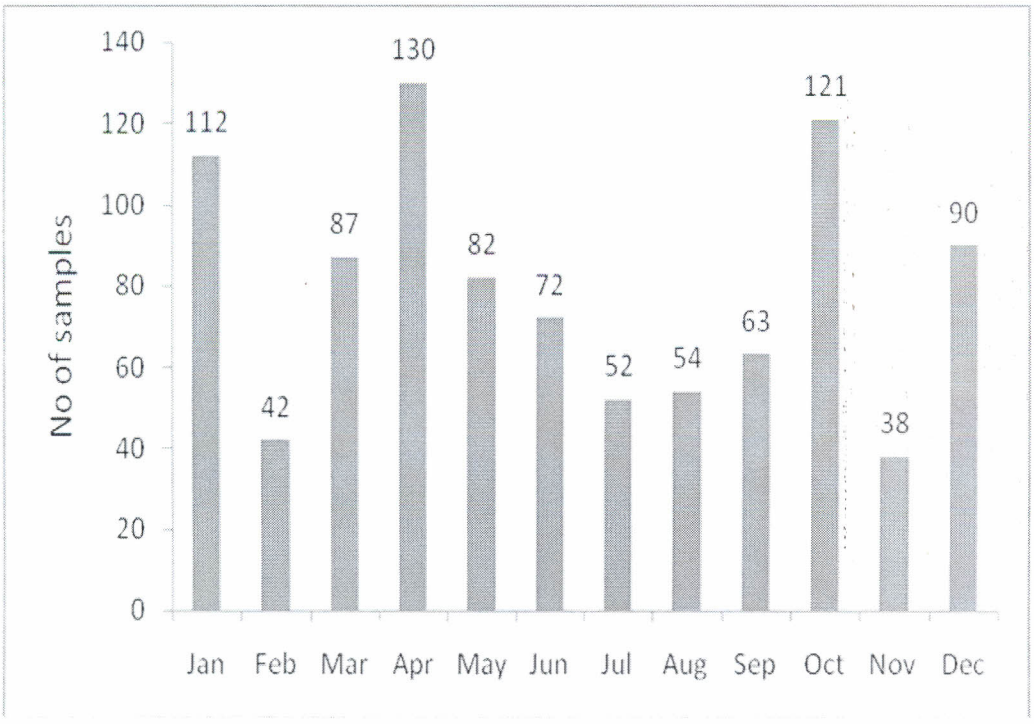


Fig 1. Nunber of samples analysed for clients in 2008

The most important clients of the Food Microbiology Division in 2008 were:

Cadbury Gh. Ltd.
Pioneer Food Cannery Ltd.
Cocoa Processing Co. Ltd
West Africa Mills Ltd.
Promasidor Ghana Ltd.
Airways Catering Ltd.
Burger Food Industries
Euro Food Gh. Ltd
Ghana Inspection Ltd.

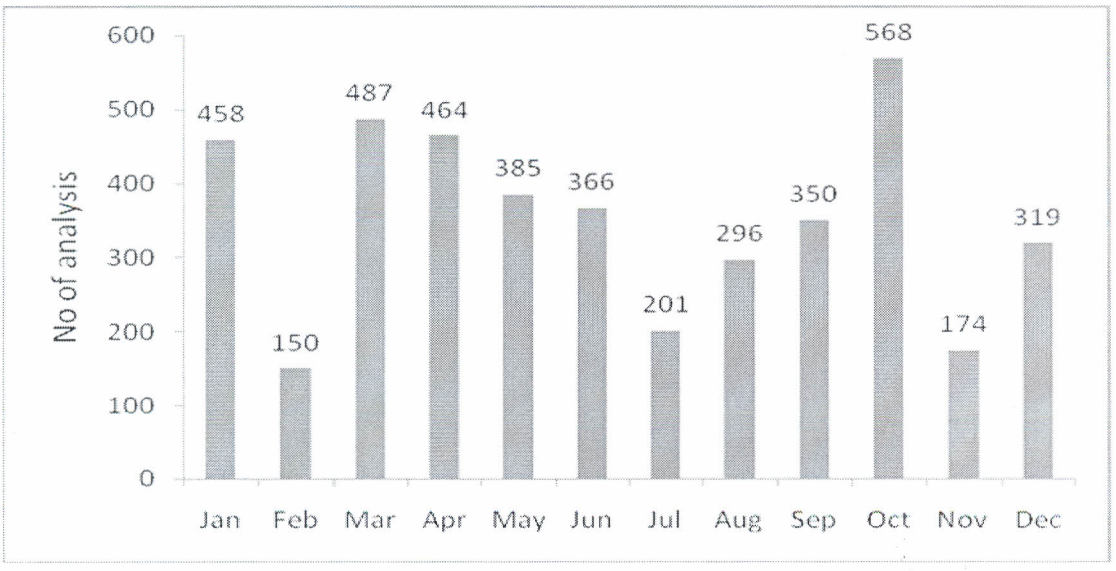


Fig 2. Number of individual analysis carried out for clients by FMD in 2008

The quality of analytical services carried out for client was assured by maintenance of the ISO 17025 for which the Food Microbiology Division has accreditation for 11 analytical methods namely:

1. Enumeration of Yeasts and Moulds. ISO 7954, 1987 (E).
2. Enumeration of presumptive *Escherichia coli.* ISO 7251, 2005.
3. Detection of *Salmonella.* NMKL No.71, 1999, 5th Ed.
4. Coliform bacteria detection in foods. NMKL No.44, 2004 6th Ed.
5. Determination of *Bacillus cereus* in foods. NMKL No.67, 2003.
6. Determination of aerobic microorganisms. NMKL No.86, 1999.
7. Detection of thermo-tolerant coliform bacteria in foods after pre-incubation
8. *Enterococcus* determination in foods. NMKL No. 68, 2004 4th Ed.
9. Aerobic microorganisms and presumptive *Enterobacteriaceae* enumeration on surfaces and utensils No. 5 2001 5th Ed.
10. Microbiological examination of fully preserved canned foods aerobic and anaerobic. NMKL No. 59 2004 5th Ed.

11. Enumeration of coagulase positive *Staphylococcus aureus* in foods. NMKL No. 66. 2003

Two internal audits were carried out during the year in February and October, 2008.

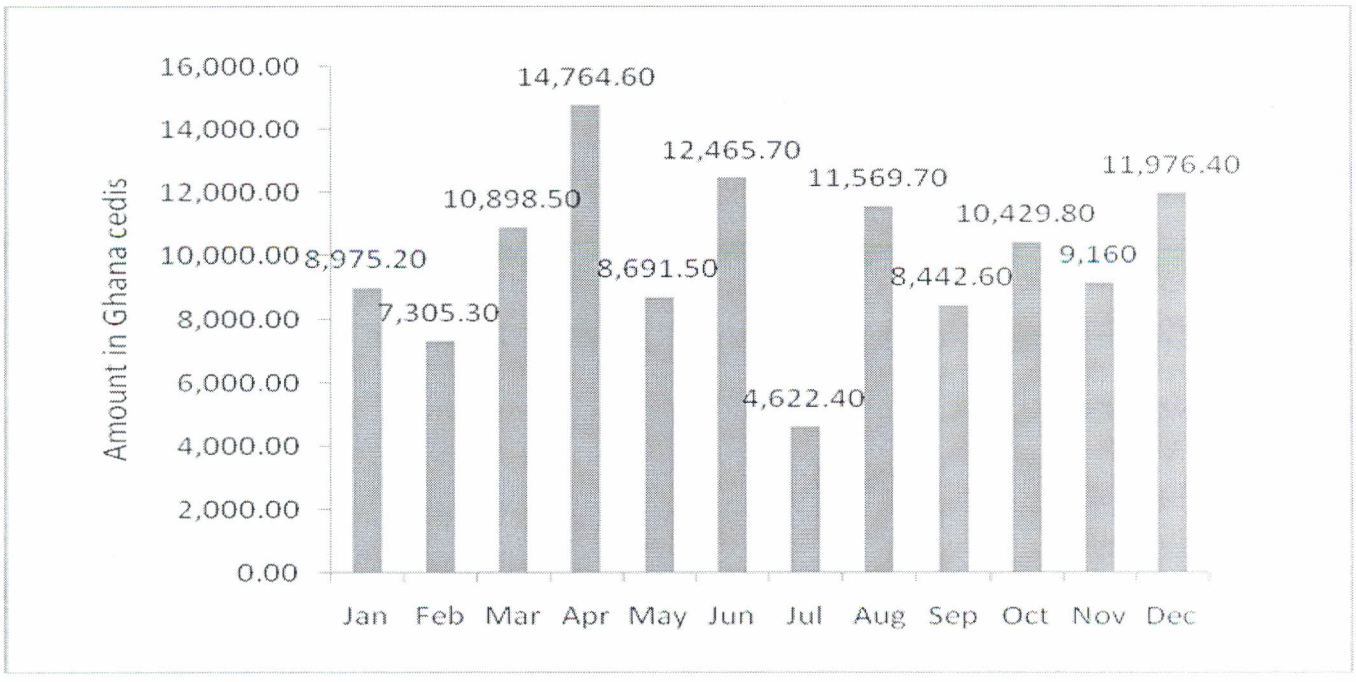


Fig 3. Monthly gross revenue generated by FMD through microbiological analytical services carried out for clients

7.5 Mushroom Unit

Production and sale of mushroom spawns and compost bags

In 2008 the total number of bottled spawns sold was 5,438 as against 2,266 in 2007. The total number of compost bags sold was 10,192 as against 2,941 in 2007. The gross amount generated in 2008 was GH¢ 8,794 as against GH¢ 2,500 in 2007. The net profit generated by the Mushroom Unit through the production and sale of mushroom spawns and compost bags in 2008 was GH¢ 3,7328 (Tables 1 & 2). There was therefore a marked improvement in the income generating activities of the Mushroom Unit in 2008.

Table 1. Production and sale of bottled mushroom spawns by the Mushroom Unit of FMD in 2008

Month	Spawn produced	Spawns sold	Amount collected (FRI)	Amount realized (Gh¢)	Profit made (Gh¢)
January	507	461	Gh¢298.00	426	
February	576	401		332.5	
March	631	465	Gh¢ 166.00	487.2	
April	889	497	Gh¢ 474.00	421.6	
May	643	497		412.6	
June	544	482	Gh¢356.00	408.8	
July	652	391		357.4	
August	815	487	Gh¢ 445.00	443.0	
September	669	529		501.0	
October	893	432	Gh¢ 456.00	616.5	
November	665	469	Gh¢ 443.20	556.8	
December	420	327		391.5	
Total	**7904**	**5438(31.2%)**	**Gh¢ 2638.2**	**5354.9(102%)**	**2716.7**

Table 2. Production and sale of mushroom compost bags by the Mushroom Unit of FMD in 2008

Month	Bags produced	Bags sold	Amount collected (FRI)	Amount realized (Gh¢)	Profit made (Gh¢)
January	1655	2026	Gh¢654.8	577.8	
February	2372	1030		279	
March	300	85		25.5	
April	1550	2051	Gh¢538	615.3	
May	1000	1126		337.0	
June	-	550		165.0	
July	-	64		19.2	
August	-	-	Gh¢ 620	-	
September	1950	808		440.3	
October	2932	2452		980.8	
November			GH¢ 611.00		
December					
Total	**11,759**	**10,192 (13.3%)**	**2423.8**	**3,439.1 (41.2%)**	**Gh¢ 1016.1**

Income generation

Gross income generated by FMD is shown in Table 3. There was an increase in the gross income generated from analytical services carried out for clients from GH¢ 79,755.86 in 2007 to GH¢ 119,301.7 in 2008. However, there was a substantial drop in the number of samples received for analysis from 1,225 in 2007 to 943 in 2008. This was due to increase in prices charged for microbiological analysis which resulted in higher revenue but loss of some clients.

Table 3: Income generated by the Food Microbiology Division

Income Generating activity		**2007**	**2008**
Analytical services	No of samples analyzed	1,225	943
	Gross income	GH¢ 79,755.86	GH¢ 119,301.7
Mushroom spawns	No of bottles produced	2,266	5438
Compost bags	No of bags sold	2,941	10,192
	Gross income Mush. Unit	GH¢ 2,500	GH¢ 8,794

The number of samples analysed The gross amount of money generated through the provision of analytical services by the Food Microbiology Division in 2008 was GH¢ 119,301.7 (1,193,017,000 old cedis) as against GH¢ 79,7558.6 (797,558,600 old cedis) in 2007 according to our records. However the number of samples analysed for clients in 2007, 1,225 was much higher the number of samples analysed for clients in 2008, 943.

7.6 Research activities carried out in the Food Microbiology Division

1. M.Phil project work of Ms Matilda Dzomeku was completed during the year.
2. Industrialization of the Ga kenkey production process phase 1: optimisation of energy and water usage. A collaborative project with the Food Process Engineering Department, University of Ghana.
3. Comparative Utilization of Rice Straw on the Growth and Yield of Three Oyster Mushrooms (*Pleurotus*) Species.

4. Performance with physical characteristics of three different pleurotus species under Ghanaian conditions
5. Determinination and identification of fungal spores (contaminants) in the mycology lab.
6. Studies on the antimicrobial activities of some edible mushrooms. (Project student from UCC)
7. Chemical composition and biodegradation of lignocellulosic materials colonized by edible oyster mushrooms: Pleurotus ostreatus. (Project student from University of Ghana)
8. Cost analysis of mushroom production in the Greater Accra Region: A case study of the Center for Scientific and Industrial Research. (Project student from University of Ghana)

7.7 Training of staff

1. Mr Theophilus Annan successfully completed his BSc degree course in Laboratory Technology at the University of Cape Coast and returned to post.
2. Ms Matilda Dzormeku completed and submitted her MSc. thesis to KNUST.
3. Ms Margaret Owusu continued her Ph.D studies on 'The Influence of fermentation method of cocoa beans and processing parameters on chocolate quality' at the Faculty of Life Sciences, University of Copenhagen.
4. Evans Agbemafle: Principles of quality assurance in testing laboratories, Ghana Institute of Pure and Applied Chemistry (GIPAC), June 14, 2008.
5. David Baisel: Principles of quality assurance in testing laboratories, Ghana Institute of Pure and Applied Chemistry (GIPAC), June 14, 2008.

7.8 Training programmes, organized by the Food Microbiology Division for Clients

The Mycology Unit organized two training programmes in 2008

1. Training in Mushroom Cultivation for 1 participant from 16th-18th September, 2008 and also from 23rd-24th September, 2008.
2. Training in Mushroom Cultivation for 9 participant from 27th- 31st October, 2008

About 20 students and 4 teachers from Achimota Senior High School visited the Unit on an educational trip. Activities included lecturing the students on mushroom cultivation using the plastic bag and the low bed methods and giving them a tour of the unit.

7.9 Conferences, Workshops and Seminar attended by staff

- Dr. W.K. Amoa-Awua: Developing Agricultural and Agribusiness Innovation in Africa, Dar es Salaam, Tanzania, May 12-14, 2008
- Dr. Margaret Ottah-Atikpo: Seminar presentation on mushroom cultivation using fish waste, Florida A & M University, Tallahassee, USA. Collaborative research on mushroom cultivation using fish waste.
- Dr, Mary Obodai: Seminar on Edible Fungi Application and dissemination for Officials. Beijing, China. May 22nd - June 5th, 2008
- Dr, W.K. Amoa-Awua, Dr. Margaret Ottah-Atikpo & Dr. Mary Obodai: First Joint Ghana-South Africa Biennial Conference on Biotechnology and materials technology. CSIR-Conference Hall, Accra, Ghana (STEPRI). 22-24th April, 2008.

7.10 National Service

Four fresh graduates started their 2008/2009 national service in the Food Microbiology Division, namely;

1. Dominic Baka
2. Josephine Narh
3. Peter Baffoe-Bonnie Jnr.
4. Comfort Ofori Essumang

7.11 Vacation training

Five students from University of Development Studies, KNUST and University of Cape coast were attached to the Food Microbiology Division during their long vacation.

PART III: RESEARCH ACTIVITIES

SECTION I

8.0 TECHNICAL REPORTS

8.1 Effect of shea butter and palm oil waxing on keeping and sensory qualities of four plantain (*Musa* AAB) varieties

I. Sugri[1], *P-N.T. Johnson*[2*] *and M. Kotey*[1]

[1]Dept. of Crop Science, College of Agric. & Consumer Sciences, University of Ghana, Legon, Accra,
[2*]Food Research Institute, (CSIR), Box M.20, Accra,

Abstract: The effect of shea butter and palm oil waxing on the pre-climacteric life and sensory qualities of four plantain varieties (*Apem, Apentu, Asamienu and Oniaba*) was studied. Waxing was achieved by brushing shea butter and palm oil on fruit surfaces. Parameters assessed were the uniformity of ripening, gloss quality and incidence of off-flavours and disorders. The fruit diameter before waxing (d1) and after waxing (d2) was measured and the difference (d2-d1) taken as the waxing thickness. Waxing thicknesses of 0.5 and 1mm resulted in irregular ripening, green-soft disorder and off-flavours. Thin layer waxing (< 0.05mm) prolonged the pre-climacteric life to 22, 20, 17, 15 days in *Apem, Apentu, Oniaba* and *Asamienu* respectively. Significant decrease ($P < 0.001$) in physiological weight loss (9.46% by 22 days of storage) compared to control (21.25% by 10 days of storage was noticed.

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8.2 Optimization of physical quality characteristics of biscuits from cassava-cowpea composite flour using response surface methodology.

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[1]Food and Drugs Board of Ghana, Box CT 2783, Accra, Ghana

[2] Food Research Institute (CSIR), Box M.20, Accra, Ghana

[3]Dept of Nutrition and Food Science, University of Ghana, Legon, Accra, Ghana

Abstract: Optimization of protein content and five physical quality of biscuits made from cowpea-cassava composite flour w investigated using response surface methodology. The central composite rotatable design for K=2 was used in studying the combined effects of cassava (45-70%) and cowpea (30-55%) levels on spread factor, biscuit weight, hardness, fracturability and colour of biscuits. Composite flour with proportions 42.5% cowpea/57.5 cassava to 55% cowpea/45% produced biscuits with significantly ($P<.05$) higher content of protein than those obtained from 100% wheat flour. The biscuit became browner in colour and less hard, decreasing from 28 N to 16 N, of cowpea flour was increased. Fracturability also increased from 0.73 to 0.33 mm with addition of 50 % cowpea flour. Models developed for these indices gave R^2 values of 95.25% for total colour change and 96.83% for hardness of the biscuits. A lack of fit test showed no significance, indicating that the models adequately fitted the data. Composite flour from cowpea and cassava blends can therefore be to produce biscuits of desirable sensory and physical qualities.

Key Words: *Cassava- cowpea composite flour, biscuits, optimization, protein and sensory qualities*

* corresponding author's email address: paanii.johnson@gmail.com

8.3 Characterization of Two Plantains *Apem* and *Apantu* from Ghana

[1]C. Oduro-Yeboah, [2]O. Gibert, [1]P-N.T. Johnson & [1]J. Gayin

[1]Food Research Institute (CSIR), Box M. 20, Accra, Ghana

[2]CIRAD Département AMIS UPR 24 – TROPIQUAL Maîtrise et intégration des procédés TA 40/15 73, Rue JF Breton34398 Montpellier Cedex 5

Abstract: Physical characteristics of *Apem* and *Apantu* plantains (*musa AAB*) from Ghana were determined. Plantain flours were prepared from ripe and unripe plantains and starch extracted from the unripe plantains. The flours and starch were evaluated for their chemical, physical, physiochemical, rheological and morphometric characteristics. The percentage amylose for the starches from both cultivars was high and similar resulting in high peak temperature. The amylose value for the flour was similar for all the cultivars of flour considered. Differences were observed in the starch qualities of ripe and unripe *Apem* and *Apantu* plantains.

8.4 Influence of processing methods on the chemical composition and rheological properties of flour from four new varieties of cassava

*J.A.Lamptey[a], P-N.T. Johnson[b] *, E.O. Sakyi-Dawson[a], C. Oduro-Yeboah[b].*

[a]Department of Nutrition and Food Science, University of Ghana,
[b]Food Research Institute (CSIR), Box M.20, Accra,
[c]Food and Drugs Board of Ghana, Box CT

Abstract: This study investigated the influence of three methods of producing cassava flour on the chemical composition and rheological properties of four new cassava varieties in order to determine the suitability for various food uses. Three processing methods (grating, slicing and reconstitution of the starch and fiber) were used to obtain the cassava flour from four varieties. The flour samples were analysed for proximate composition, starch, reducing and non-reducing

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sugars, free cyanide as HCN, non-glucoside cyanogens and total cyanogens. Pasting characteristics of the flour were determined using the Brabender viscoamylograph. Both the variety and the method o flour production significantly affected flour chemical composition. The protein, ash, sugar and fibre were lowest in reconstituted flour (RCFs) though the starch content was highest. Cyanogens levels in the flours were also significantly affected by processing methods. Reconstituted flours had lowest the cyanogenic potential. The total cyanogens ranged from 0.083 for RCF to 1.834 mg CN equiv/Kg for flours produced by slicing. Slicing produced flours with the lowest peak paste viscosities (298 BU to 456BU), whilst that of RCF were highest (714BU to 914BU). All other rheological indices were also lowest for flours produced through slicing. The reconstitution method significantly reduced the total cyanogens of the flours with higher viscosities. The viscosities of grated cassava flours were however more suitable for baking.

Key Words: Cassava flour, processing methods, chemical and rheological properties.

8.5 The potentials of maximizing the processing of pineapple (*Ananas comosus*) and its organic side-streams

Fosu, E[1] and P-N. T. Johnson [2]

[1]Nkulenu Industries Limited, Box 36, Accra
[2]Food Research Institute (CSIR), Box M.20, Accra

Abstract: Pineapple (*Ananas comosus*) production and its export play a major role in the non-traditional foreign exchange earnings of Ghana. The very high quality standard requirement of the export market, in terms of size, colour and absence of defects in the fruits however, means that a sizeable proportion of the pineapple produced in Ghana are not exported. Most of the non-exportable pineapple fruits are processed into juices, drinks and concentrates and sold in Ghana. Unfortunately, only 60% of the fruit is usually processed into these value-added products; the rest being largely considered as waste. This high proportion of waste is affecting the cost of production and therefore the competitiveness of these value-added products on the Ghanaian markets. This paper reports on a study carried to maximize the value-added products that can be obtained

from pineapple and its organic side-streams. The study revealed that it is possible to reduce the proportion of the organic side -stream from 40 to 20 % through use of innovative processing methods. The value-added products obtained from these organic side-streams have been demonstrated to have very good market potential. The characteristics of the value added products of the organic side-stream are described. The paper also highlights challenges that need to be overcome.

8.6 Understanding the concept of food sovereignty using the Ghana School Feeding Program (GSFP)

Quaye[1] Wilhelmina, Essegbey[2] George, Frempong[2] Godfred and Ruivenkamp[3] Guido

[1] Food Research Institute (CSIR) Box M20, Accra [2] Principal Research Scientist, Science and Technology Policy Research Institute (CSIR) Box CT519, Accra-Ghana; [3] Professor at the Athena Institute of the Vrije Universiteit, Amsterdam

Abstract: This paper demonstrates the usefulness of the emerging food sovereignty concept using a home grown school feeding program that promotes local food demand – supply linkages. It analyses the Ghana School Feeding Program in four districts with respect to community involvement in program organization and management as well as socioeconomic impacts. A combination of quantitative and qualitative methodological approaches has been used in data collection. Results showed a significant improvement in Household Food Access and Months of Adequate Household Food Provisioning , which have been used as proxies for food sovereignty, as a result of access to local market created by the Ghana School Feeding Program. However, the study recommends more empirical evidence from research to support the claim that using locally produced food for school feeding actually reduces poverty and malnutrition in rural farming communities.

SECTION II

9.0 DEVELOPMENT REPORT

Report On the Accreditation Project of CSIR-FRI Chemical and Microbiological Laboratories

1. Introduction

The Food Research Institute has established and is implementing a quality management system according to ISO/IEC 17025: Standard since August 2001. The main objective was to obtain accreditation for 4 chemical, one mycotoxin and 13 microbiological methods to ISO/IEC 17025: Standard. This was to ensure that the Food Research Institute's Chemistry and Microbiological laboratories produce technically valid analytical results that can be internationally accepted by customers.

In the previous year, the Institute obtained accreditation for 11 microbiological and 4 chemical methods from the South African National Accreditation System (SANAS). This report covers the activities of the FRI Quality Management System implemented in the Chemistry, Mycotoxin and Microbiology laboratories; Customer services Unit of the Commercial and Information Division (CID) and the Stores and Purchasing Units of the Accounts Division., for the year January to December, 2008.

2.0 Activities

2.1 Internal Audits

According to the FRI Quality Management System, a minimum of two internal audits are to be conducted annually in each of the three laboratories i.e. Chemistry, Mycotoxin and Microbiology; the Client Services Unit of the CID and the FRI Stores to verify whether the operations comply with the requirements of FRI Quality Management System and the International Standard ISO/IEC 17025 and also whether the defined methods, procedures and instructions as stated in the documents are properly carried out.

Two internal audits were conducted during the year, one in March and the second in October. The audits were conducted by Dr. P.N.T. Johnson and Dr. Charles Tortoe both of the Processing and Engineering Division of the Food Research Institute.

Twenty nine non-conformances were identified in the two audits conducted in 2008. These were broken down as follows: Microbiology Laboratory – 10; Chemistry Laboratory – 2; Mycotoxin Laboratory – 10; Customer Services – 6 and Purchasing & Stores – 1.

2.2 Management Review Meetings

Management review meetings are held twice a year to ensure the continuous suitability and effectiveness of the quality management system and introduce necessary changes and improvements.

Two meetings were held on 9th May and 17th December 2008, respectively.

The main matters discussed were: Status of work in the Divisions; Problems and difficulties encountered ; Suggestions for improvements; Internal /External Audit findings; Corrective and preventive actions; Results of Proficiency tests and Internal quality controls; Purchasing/Procurement; Customer feedback and Complaints; Resources and Staff training and Other matters.

Members of the Management Review Meeting include the Director (Chairperson); Deputy Director; Head Microbiology Division; Head Chemistry Division; Head Commercial and Information Division; Head Accounts and Stores Division; Head Administration Division and the Quality Manager as Member/Secretary.

2.3 Participation in Proficiency Tests/Inter Laboratory Comparisons

The Microbiology Laboratory participated in General Food and Dairy Microbiology Scheme organized by Bio Services UK Ltd. (formerly known as Senate QA Proficiency Testing Scheme, Great Britain).

The laboratory performed satisfactorily in these tests but when unsatisfactory z-scores were obtained corrective actions were taken as required.

The Chemistry Laboratory also participated in an inter laboratory comparisons organised by the Argentinean Accreditation Body (OAA) and National Institute of Industrial

Technology as Proficiency testing provider in collaboration with IAAC. The South African National Accreditation System (SANAS) selected the Chemistry Laboratory to participate in this exercise together with 53 laboratories from IAAC region, 7 laboratories from APLAC region and 9 laboratories from SADCA (South Africa) region.

A meat sample was analysed for fat, moisture, protein and ash by the laboratories.

The Chemistry laboratory had satisfactory z-scores of $\leq$-2 for three of the four tests carried out.

2.4 Quality Assurance of Agricultural Products through Improved Metrological and Testing Services

2.4.1 Introduction

The project 'Quality assurance of agricultural products through improved metrological and testing services' is a Technical Cooperation Project between Ghana and Germany initiated December 2007 by the National Metrology Institute of Germany- (Physikalisch-Technische Bundesanstlt(PTB)).

The aim of the project is to support the establishment of a consolidated and adequate quality infrastructure to guarantee the quality and safety of food and agricultural products in Ghana. This objective is being achieved through the following:

- Strengthening the competence and capacity of analytical and metrology laboratories
- Supporting and promoting networking activities among these laboratories and other relevant organizations and authorities
- Providing policy advice in the quality infrastructure sector for optimal task allocation and cooperation amongst competent authorities
- Providing practical support to Ghana's quality infrastructure institutions on the road to international recognition.

The Project Partners are the Ghana Standards Board (GSB) and CSIR Food Research Institute (FRI). The Political Counterpart for the project is the Plant Protection and Regulatory Services Directorate of the Ministry of FOOD and Agriculture.
The laboratories involved in the first phase of the project are the Metrology laboratories (Mass, Temperature, Pressure and Volume) and Food Laboratory (Heavy Metals) of Ghana Standards Board; and the Mycotoxin Laboratory of CSIR Food Research Institute.

Selected activities under the project include:

- Consultancy missions by international experts
- Hands on training of technical laboratory staff
- Supply of laboratory equipment
- Participation in inter-laboratory comparisons
- Information and outreach events
- High-level expert round tables and workshops
- Study visits and educational attachments

The project is scheduled to have a total duration of ten years divided over three implementation phases. The first phase is from December 2007 to November 2011 with a budget of 900,000 EUR.

2.4.2 Activities carried out under the project in 2008

a). Working Mission in February 2008

As one result of the planning workshop in December 2007, it was agreed to support the Heavy Metals Laboratory of GSB as well as the Mycotoxins Laboratory of CSIR FRI in order to finnaly achieve accreditation to ISO 17025 for both laboratories.
It was also agreed that the first working mission will evaluate the existing methodology, expertise and analytical equipment of both laboratories and also identify a strategy for further work.
The mission by the Project consultant Dr. Ulrich Nehring of the Institute Nehring GmbH, came on from 12th to 13th February 2008. Evaluation of the Mycotoxin Laboratory was made and recommendations given for investments and future steps of the project.

b). Conference on 'Competence and Technology for Safer Food and Increased Agricultural Exports' – 17th June 2008.

The conference was organized by the PTB in collaboration with Ghana Standards Board and supported by the CSIR- Food Research Institute with sponsorship from the PTB under the ongoing project. It was held at the La Palm Royal Beach Hotel in Accra, Ghana.

The conference presented and discussed the following major themes:

I. The road to international recognition: Traceability, laboratory quality assurance, accreditation by Dr. Robert Kaarls (BIPM)
II. From certified reference materials to safer food by Dr. Robert Kaarls (BIPM)
III. Scientific and technological support to Ghana's agricultural and food sectors by Dr. Paa Nii Johnson (CSIR Food Research Institute)
IV. Food Safety in Ghana: A critical analysis by Prof. Sefa Dedeh (University of Ghana, Legon)
V. Competence in Food Testing: the need for individual upgrading and improved cooperation by Dr. Ulrich Nehring (Institut Nehring- a private accredited Food Lab in Germany).
VI. Presentation of the PTB project 'Quality assurance of agriculyural products through metrological and testing services' by Mrs. Carola Heider, Mr. Alex Inklaar (PTB).

The conference was attended by 5 members of the Institute. They are Dr. PNT Johnson, Dr. W. K. Amoa-Awua, Dr. Mary Halm, Dr. (Mrs.) Pearl Adu- Amankwa and Dr. (Mrs.) Kafui Kpodo.

c). Seminar on 'Estimation of Measurement Uncertainty in Analytical Laboratories'

This seminar was held at the Ghana Standards Board Training Room from 3rd to 4th November 2008. Participants were from the GSB, CSIR Food Research Institute, Food

and Drugs Board, Atomic Energy Commission, Customs Excise and Preventive Service and the University of Ghana Legon. Six participants from the Food Research Institute attended this seminar as follows: Dr. Mary Halm, Dr. (Mrs.) Kafui Kpodo, Dr. (Mrs.) Margaret Atikpo, Mr. Charles Diako, Mr. David Asiedu and Mr. William Amevor..

The seminar programme included:

- Lecture inputs in metrology in chemistry, traceability of measurement results, managing quality in environmental analysis, estimation of measurement uncertainty in analytical labs
- Practical exercises
- Group work and presentation and discussion of group results
- Visit to GSB metrology labs and demonstration of traceability of measurement results by lab staff
- Information on available free materials and standards guidance

The resource person was Dr. Martina Hedrich of the Federal Institute for Material Research and Testing (BAM) Germany

d). Workshop on networking between laboratories 5th November 2008

This workshop took place at the Ghana Standards Board Training Room and was attended by the same participants as for the seminar on 'Estimation of measurement uncertainty in analytical laboratories'

The workshop agenda included:

- Welcome and introductions
- Evaluation and feedback on seminar on 'Estimation of measurement uncertainty in analytical laboratories'
- Priority topics for future Experts workshops
- PTB proposal concerning 'Awareness Poster'
- Idea for new project activity 'Improved conditions for purchasing , maintenance and servicing of sophisticated equipment for analytical labs in Ghana
- Networking between metrology and testing laboratories: MoU

The following scope for networking between laboratories was confirmed by the participants:

- Joint maintenance and servicing of equipment. (Example by reporting to acoordinator, creating a database of equipmentused and training a technician who can serve all clients that have similar equipment or equipment from the same supplier)
- Sharing of expertise
- Joint training activities
- Build confidence among labs
- Improved exchange and coordination to avoid unnecessary overlap.

An ad-hoc MoU group was nominated with the aim of preparing the first draft of a feasible MoU potentially acceptable to all relevant parties. The following were nominated as members of the ad-hoc group:

Dr. Mary Halm (CSIR-FRI); Mr. Percy Adomako Agyekum (FDB); Mrs. Felicia Ibrahim (GSB); Mr. Prince Niafe (CEPS) and Mrs. Haruna (Atomic Energy Commission). Letters were subsequently sent to the Institutions of the nominees for confirmation of their nominations.

e). Seminar on Metrology in Chemistry

The PTB sponsored the Head of Chemistry Division Dr. (Mrs.) Kafui Kpodo to participate in the Seminar on Metrology in Chemistry held in Nairobi, Kenya from 25th to 27th August 2008.

APPENDIX I

FRI STAFF LIST (2008)

Directorate

1. Dr. W. A. Plahar - Director
   BSc (Gen.), BSc (Hons) MSc Fd. Sci. (Ghana) (Chief Research Scientist)
   PhD (Washington)

2. Dr. P. N. T. Johnson - Deputy Director
   BSc (Hons), Biochem. (UST) (Principal Research Scientist)
   MSc. Agric. Eng. (Cranfield)
   PhD Food Sci. & Tech. (Reading)

3. Dr. Mary Halm - Quality Manager
   BSc (Gen.) BSc (Hons), MSc Botany (Ghana) (Senior Research Scientist)
   Post Grad. Dip. Rural Fd. Tech (Netherlands)
   PhD (Ghana)

4. R. M. Yawson - Senior Scientific Secretary
   BSc. (Hons) M. Phil. (Biochem) Ghana
   Post Grad. Cert. Fd. Mgt. (Jerusalem)

5. S. Nketia - Scientific Secretary
   BSc. (Hons) Zoology& Botany (Cape Coast)
   MSc. (Fd. Sci. & Tech) KNUST
   MBA (KNUST)

6. F. Mante (Mrs.) - Snr.Admin Assistant
   Diploma in Business Studies (Sec)

Food Microbiology Division

1. Dr. W.A. Amoa -Awua - Head of Division
   BSc (Ghana) MSc. App. Sci. (Principal Research Scientist)
   (New South Wales)
   PhD (Ghana)

2. Dr. M. Ottah-Atikpo (Mrs.) - Research
   Scientist
   BSc Microbiology, MSc Fisheries (ABU, Zaria)
   PhD. (Ghana)

3. Dr. M. Obodai (Mrs.) - Research Scientist
BSc (Hons), MPhil. Botany (Ghana)
PhD University of Nottingham UK

4. M. Owusu (Ms.) - Research Scientist
BSc (Hons), MPhil. Botany (Ghana)

5. Peter Adoquaye Addo - Research Scientist
BSc. (Biological Sciences) Cape Coast
MPhil (Biological Sciences) KNUST

6. Matilda Dzomeku (Mrs.) - Asst. Res. Scientist
BSc Biological Sciences (KNUST)

7. Amy Atter (Mrs.) - Asst. Scientific Officer
BSc Lab. Tech. (UCC)

8. Frederick A Sarpong - Asst. Scientific Officer
BSc Lab. Tech. (UCC)

9. Deborah L. Narh - Asst. Res. Scientist
BSc. (KNUST)

10. Nina Nkrumah - Asst. Scientific Officer
BSc Lab. Tech. (UCC)

11. Evans Agbamafle - Asst. Scientific Officer
BSc. Lab. Tech (UCC)

12. D. K. Asiedu - Snr. Technologist

13. D .K. Baisel - Technologist

14. R. Takli - Asst. Technologist

15. M. Amoo-Gyasi - Asst. Technologist

16. Theophillus Annan - Technical Officer
Diploma in Lab. Tech (UCC)

Food Chemistry Division

1.	Dr. (Mrs.) K. Kpodo BSc (Gen.) BSc (Hons) Ghana MPhil (West Indies) PhD (Ghana)	-	Head of Division (Senior Research Scientist)
2.	G. A. A. Anyebuno BSc (Hons), MPhil. Botany (Ghana)	-	Research Scientist
3.	C. Diako BSc (Hons), Fd. Sci & Nut. (Ghana)	-	Asst. Res. Scientist
4.	F. Y. Mensah	-	Asst. Scientific Officer
5.	W. K. Amevor	-	Snr. Technologist
6.	P.Mensah Toku	-	Snr. Technologist
7.	D. N. A. Ankrah	-	Technologist
8.	N.Y. Amey	-	Technologist
9.	Jeremiah Lartey- Brown	-	Technical Officer
10.	Mercy Fianu	-	Technical Officer
11.	Vida Awidi	-	Technical Officer
12.	Belinda Ayitey Adjin	-	Technical Officer

Nutrition & Socio-Economics Division

1.	W. Quaye (Mrs.) BSc (Hons) MPhil Agric. Econs (Ghana)	-	Research Scientist
2.	M. Glover Amengor (Mrs.) Bsc.(Hon)Biochem. MSc. Environ. Sci. &Tech, MSc. Public Health	-	Research Scientist
3.	A. Kuevi (Ms.) BSc Fd Sci &Nutri. (University of Ghana) MPhil in Nutrition (University of Ghana)	-	Research Scientist
4.	I. Yawson (Mrs.) BSc (Hons) Fd. Sci & Nut. (Ghana)	-	Assistant Research Scientist
5.	L.Hagan (Mrs) BSc (Hons) Home Sci. (Ghana)	-	Assistant Research Scientist
6.	B. Kudjawu (Ms.)	-	Assistant Research Scientist

BSc (Hons) Home Sci. (Ghana)

7. E. Ayeh (Ms) - Assistant Research Scientist
   Bachelor of Education (UCC)
8. I. A. Tamakloe (Mrs.) - Chief Tech. Officer
9. Alice Padi (Mrs.) - Technical Officer
10. Constance Boateng - Technical Officer

Commercialization & Information Division

1. Dr. P. Adu-Amankwa (Mrs.) - Head of Divison
   BSc (Hons) Biochem (UST) (Senior Research Scientist)
   MSc. Fd. & Mgt. Sci., EMBA(UG)
   PhD Post-Harvest Physiology (Lond.)

2. K.A. Bugyei - Asst. Scientific Info. Officer
   BA Computer Science &Econs
   (University of Ghana)

3. A. Andoh - Chief Tech. Officer
4. B. Awotwi - Chief Tech. Officer
5. R. Kavi - Jnr Asst Librarian
6. B. P. Osae - Principal Technical Officer
7. P.O. Baidoo - Technical Officer
8. Joana B. Dzikunu - Snr. Admin. Assistant
9. Mary Assimah - Admin. Assist.

Food Processing & Engineering Division

1. Dr. P. N. T. Johnson - Head of Division
   BSc (Hons), Biochem. (UST) (Principal Senior Research Scientist)
   MSc. Agric. Eng. (Cranfield)
   PhD Food Sci. &Tech. (Reading)

2. Dr. N. T. Dziedzoave - Senior Research Scientist
   BSc (Hons), Biochem. (UST)
   Post Grad. Dip. in Fd. Sci. & Nut., (Gent, Belgium)
   MSc Fd. Sci. & Tech. (UST)
   PhD (Greenwich)

3. Dr. J. T. Manful - Senior Research Scientist
   BSc (Agric), Dip. Ed. (Cape Coast)
   MPhil Biochem. (UST)
   PhD (Greenwich)

4. D. Blay - Research Scientist
   MSc Chem. Eng. (Moscow)

5. E. C. Tettey - Research Scientist
   BSc (Hons) Agric (UST)
   Post-Grad. Dip. Fd. Tech.,
   MPhil, (Humberside)

6. Dr. L. D. Abbey - Research Scientist
   BSc (Hons), Biochem. (UST)
   MSc. App. Sci. (Fd. Tech.) New South Wales
   PhD (Ghana)

7. C. K. Gyato - Research Scientist
   Nat. Dip. in Agric. Mech. (Ghana)
   MSc Agric. Eng. (Bulgaria)

8. Dr. K. A. Vowotor - Research Scientist
   B.Sc. Zoology Dip. Ed. (Cape Coast)
   M. Phil. PhD (Ghana)

9. B.A. Mensah - Research Scientist
   MSc. Fd. Pross. Tech. (Kransnodar, USSR)

10. S. K. Noamesi - Research Scientist
    BSc (Agric) MSc Fd. Sc. (Ghana)

11. J. Gayin - Research Scientist
    BSc (Hons) Biochem (UST)
    MSc Fd. Tech. (Gent)

12. Dr. C. Tortoe - Research Scientist
    BSc (Hons), MPhil. Botany (Ghana)
    PhD (Greenwich, UK)

13. G. A. Komlaga - Research Scientist
    BSc (Hons) Biochem (Ghana)
    MSc Fd. Sc. & Tech. (UST)

14. C. Oduro-Yeboah (Mrs.) - Research Scientist
    BSc (Hons) Biochem (Ghana)
    MPhil (Ghana)

15. E. A. Baidoo BSc (Hons) Biochem (UST)	-	Asst. Res. Scientist
16. S. A. Sampare	-	Chief Tech. Officer
17. J. R. Addo	-	Snr. Tech. Off.
18. E. Ablorh	-	Snr. Tech. Off.
19. J. A. Asafu-Adjei	-	Prin. Works Supt
20. R. Y. Anthonio	-	Prin. Works Supt.
21. R. M. Mawuli	-	Works Supt.
22. J. L. Lamptey	-	Works Supt.

Accounts Division

1. N. Adoboe-Mensah ICA Ghana	-	Head of Accounts
2 J. Mintah Nakotey	-	Chief Stores Supt.
3. C. Aikins Tutu	-	Chief. Accounting Asst.
4. K. K. Aidoo	-	Chief Accounting Asst.
5. C. Amega	-	Snr.Accounting Asst.
6. S. O. T. Oddoye	-	Prin. Stores Supt.
7. G. O. Gyamfi	-	Prin. Stores Supt.
8. J. K. Larbi	-	Accounting Asst.

Administration Division

1. J. Aggrey –Yawson (Ms.) Institute of Chartered Sec & Administrators Certificate in HRM	-	Asst. Admin Officer.
2. J.F. Asigbey	-	Chief Admin. Asst.
3. E. A. Larbi	-	Chief Works Supt.
4. G. Aklieh	-	Prin. Works Supt.
5. C. Ketsie (Ms.)	-	Admin Asst.
6. Eric Ofori	-	Admin Asst
7. Victoria Alambire (Ms.)	-	Admin. Assistant
8. Beullah Adadevor-Sallah (Mrs.)	-	Admin. Assistant

APPENDIX II

RESEARCH REPORTS, PAPERS PRESENTED AT CONFERENCES, SEMINARS AND MEETINGS

Edited Research Report

Johnson, P-N.T., Oduro-Yeboah, C. and J. K. Gayin (2008) Validation of good Manufacturing Practices used by Micro-small and Medium-scale Processors in Ghana for juices and other products from bananas and Plantains **CSIR-FRI/RE/JP-NT/2008/001**

Sugri, I, M. Kotey M. and **Johnson P-N.T (2008)** Effect of using shea-butter and palm oil as post-harvest waxing treatment on the keeping quality of four plantain varieties. **CSIR-FRI/RE/SI/2008/002**

Fosu, E.K & **Johnson P-N.T. (2008)** Developing value-added products from organic side streams of fruits processed by Nkulenu Industries Limited. African Knowledge Transfer Partnership Project. Report **CSIR-FRI/RE/FEK/2008/003**

Oduro-Yeboah C., Johnson, P-N. T. Sakyi-Dawson, E. O. & Budu A.S. **(2008)** The Acceptability of Five Varieties of Cassava for Local Food Uses Based On Pasting Characteristics. Technical Report Submitted to Food Research Institute (CSIR), Accra, Ghana **CSIR-FRI/RE/O-YC/2008/004**

Oduro-Yeboah, C., Johnson, P-N.T. and Sakyi-Dawson, E. **(2008)** Colorimetric Measurement of Cassava Starch and Flour from Five Different Varieties of Cassava. Technical Report Submitted to CSIR-Food Research Institute, Accra, Ghana. **CSIR-FRI/RE/O-YC/2008/005**

Lamptey, J. A. Sakyi-Dawson, E. O. **Johnson, P-N. T.** & Annor, G. A.**(2008)** Effects of different methods on the nutritional composition and cyanogenic content of flour from new and promising cassava varieties, Processings of 1st Scientific Meeting, Global Cassava Partnership, Ghana University of Belgium, 21-25, July, 2008. **CSIR-FRI/RE/LJA/2008/006**

Lamptey, J. A. **Johnson, P-N. T.** & Sakyi-Dawson, E. O. **(2008)** Optimization of quality characteristics of biscuits from cassava-cowpeacomposite flour using response surface methodology. Submitted to LWT- Food Science and Rechnology,, Ghana University of Belgium, 21-25, July, 2008. **CSIR-FRI/RE/LJA/2008/007**

Johnson, P-N.T., **Oduro-Yeboah,** C., Staver, C, & **Gayin, J. (2008)** Validation of processing methods and good manufacturing practices (GMPs) used by micro-scale, small and medium-scale processors in Ghana for juice and other products from banana and plantain. Bioversity International. CSIR-FRI Banana and Plantain Project

CSIR-FRI/RE/JP-NT/2008/008

Gayin, J., Sampare A. S., Mensah, M. & Johnson, P-N. T (2008). Report on Workshop to Introduce Cereal Meal Fortification with Selected Vitamins and Minerals to Three WFP-Beneficiary Communities in Northern and Upper East Regions of Ghana. CIDA/WFP/CSIR-FRI Community Based Cereal Milling and Fortification Project. FRI Report. **CSIR-FRI/RE/GJ/2008/009**

Wuxin, Z., **Gayin, J.**, Chatel, F., Dewettinck, K. and Van der Meeren, P., **(2008).** Influence of Electrolytes on the Heat-Induced Swelling of Aqueous Dispersions of Native Wheat Starch Granules (submitted for publication) **CSIR-FRI/RE/WZ/2008/010**

Amoa-Awua, W., Pearl Adu-Amankwa, Kwame Vowotor, Benjamin Mensah, Cletus Gyato, Joseph Gayin, Charles Tortoe, George Anyebuno, Ali Sampare, (2008). Training needs assessment of twelve Farmer Based Organizations in the West Mamprusi district in the Northern Region of Ghana. MiDA Agricultural Project report.
CSIR-FRI/RE/AAW/2008/011

Tortoe, C., Johnson, P-N. T., Atikpo, O. M. (2008). Modules for managing Street/Informal Food Sector in Ghana. FRI/CSIR, Accra, Ghana. pp. 65.

CSIR-FRI/RE/TC/2008/012

Tortoe, C., Oduro-Yeboah, C., Johnson, P-N. T., Hoornstra, E. & Slaghek,T. **(2008).** Utilization of organic side-streams of pineapples for Small Scale Processing for the local markets in Ghana. TNO/CSIR-FRI Pineapple Project. FRI/CSIR, Accra, Ghana. pp.14. **CSIR-FRI/RE/TC/2008/013**

Ofori, E. O and **Tortoe, C.** (2008). The effect of osmotic dehydration on caroteniod the caroteniod concentration of banana (*Musa spp.* var. Cavendish *sp.*) and papaya (*Carica papaya* var. Golden exotic). GATSBY/CSIR/MOFA Banana and Plantain Project. FRI/CSIR, Accra, Ghana. pp. 48. **CSIR-FRI/RE/OEO/2008/014**

Refereed Journals Papers

Kostinek, M., Ban-Koffi, L., Ottah Atikpo, M., Teniola, D., Schillinger, Ulrich., Holzapfel H. W. and Franz, M.A.P. C. **(2008).** Diversity of predominant lactic acid bacteria associated with cocoa fermentation in Nigeria. *Current Microbiology* **56**: 306 - 314. **CSIR-FRI/JP/KM/2008/001**

Ottah Atikpo, M, Oghenekome Onokpise, Michael Abazinge, Clifford Louime, Matilda Dzomeku, Linda Boateng and Bawa Awumbilla.**(2008).** Sustainable mushroom production in Africa: A case study in Ghana. Accepted for publication in *African Journal of Biotechnology* Vol. 7 (3), pp. 249 – 253. **CSIR-FRI/JP/OAM/2008/002**

Frimpong A. **Johnson, P-N.T & Baidoo, E.** (2008) Agronomic and nutritional characteristics of fourteen Ghanaian groundnut varieties. Tropical Science. 48 Publish online, Early View, www.wileyscience.com April 28 2008. **CSIR-FRI/JP/FA/2008/003**

Jumah A., **Johnson, P-N T., Quayson E., Tortoe, C.,and Oduro-Yeboah, C.,(2008)** Market Testing of A Major Cassava Flour Product in the Accra Metropolitan Area International Journal of Consumer Studies ISSN 1470-6423 (2008) **CSIR-FRI/JP/JA/2008/004**

Manful, J.T., Grimm C.C., **Gayin J.** and Coker R.D. **(2008)** Effect of Variable Parboiling on crystallinity of Rice Samples. Cereal Chem. 85(1) 2008. Pp92-95 **CSIR-FRI/JP/MJT/2008/005**

Himmelsbach, D.S., **Manful, J.T.,** and Coker R.D. **(2008)** Changes in Rice with Variable Temperature Parboiling: Thermal and Spectroscopic Assessment. Cereal Chem. 85(3) 2008. Pp384-390 **CSIR-FRI/JP/HDS/2008/006**

Tortoe, C, Johnson, P-N.T. & Nyarko, A. I. (2008) Effects of osmo-dehydration, blanching and semi-ripening on the viscoelastic, water activity and colorimetry properties of flour from three cultivars of plantain (Musa AAB). J. Innovative Food Science and Emerging Technologies. Published Early View. http://dx.doi.org/10106/j.ifset. 3rd August 2008. **CSIR-FRI/JP/TC/2008/007**

Banu, R. A. Odamtten G. T and **Kpodo, K.** (2008) Comparative Moisture Sorption, Insect Infestation And Aflatoxin Production By Resident Aspergillus Flavus Linkspores In Solar And Sun Dried Cassava Accessions Before And After Gamma Irradiation. *Journal of the Ghana science Association* Department of Botany University of Ghana , Legon **CSIR-FRI/JP/BRA/2008/008**

Tortoe, C., Obodai, M., Amoa-Awua, W., Oduro-Yeboah, C. and Vowotor, K. (2008). Effectiveness of three different storage structures and curing process for the storage of sweetpotato (*Ipomea batatas*) in Ghana. *Ghana Journal of Agriculture Science* Vol 43(2008) **CSIR-FRI/JP/TC/2008/009**

Tortoe, C. and Clerk, G. C. (2008). Utilization of nutritional compounds and sclerotial development of *Sclerotium rolfsii* isolated from *Elaeis guineensis* and *Xanthosoma mafaffa* in Ghana. *Journal of Ghana Science Association.* (Accepted 12 December, 2008). **CSIR-FRI/JP/TC/2008/010**

Tortoe, C., Orchard, J., Beezer, A. and Tetteh, J. (2008). Artificial neural networks in modeling osmotic dehydration of foods. Journal of Food Processing and Preservation **32**, 270-285. **CSIR-FRI/JP/TC/2008/011**

Tortoe, C., Orchard, J., Beezer, A. (2008). Artificial cell studies in simulated apple and potato starch cell complex during osmotic dehydration. Journal of Food Quality 31, 559-570. **CSIR-FRI/JP/TC/2008/013**

Obodai M. and M. Apertorgbor (2008) Proximate composition and nutrient content of some wild and cultivated mushrooms of Ghana. Journal of the Ghana Science Association. **CSIR-FRI/JP/OM/2008/014**

Quaye, W., J Gayin, I. Yawson and Plahar W.A. (2008). Characteristics of Various Processing Approaches and Adoption Requirements. Journal of Root Crops Vol. 34 No 2 Issue of 2008. **CSIR-FRI/JP/QW/2008/015**

Quaye, W. (2008) Food Security Situation in Northern Ghana, coping strategies and related constraints. *African Journal of Agricultural Research* Vol. 3(5). Pp. 334 – 342, May 2008 **CSIR-FRI/JP/QW/2008/016**

Yawson R.M., W., Quaye, I. Entsi Williams and **I. Yawson (2008)**. A Stakeholder Approach to Investigating Public Perception and Attitudes towards Agricultural Biotechnology in Ghana. *Tailoring Biotechnologies* Vol. 4 Issue 1/2;Fall-2008, pp: 55-70. **CSIR-FRI/JP/YRM/2008/017**

Quaye, W., Gayin, J., Yawson I and Plahar W.A. (2008). Characteristics of Various Processing Approaches and Adoption Requirements. Accepted for publication in *Journal of Root Crops* Vol. 34 No 2 Issue of 2008. **CSIR-FRI/JP/QW/2008/018**

Quaye, W. , I. Yawson and W.A. Plahar (2008). Bambara Marketing Margins Analysis in Ghana. Accepted for publication in Vol.48(2008) of the *Ghana journal of Science*
CSIR-FRI/JP/QW/2008/019

Quaye, W. , I. Yawson and W.A. Plahar **(2008).** Adoption and Impact of High Quality Bambara Flour Technology in the Northern Region of Ghana Accepted for publication in Vol.43(2008) of the *Ghana journal of Agricultural Science*
CSIR-FRI/JP/QW/2008/020

Quaye, W. , W.A. Plahar and Yawson I. **(2008).** Processors' perceptions of various processing technologies: A case study of selected districts in Ghana. Accepted for publication in Vol.43(2008) of the *Ghana journal of Agricultural Science*
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CSIR-FRI/BK/JP-NT/2008/002

APPENDIX III

CONFERENCES, COURSES, WORKSHOPS AND SEMINARS ATTENDED BY FRI STAFF IN 2008

Conferences/ Courses/ Workshops/Seminars	Participants	Designation	Venue	Date/Duration	Organizers
Food Safety Training workshop	Dr. PNT Johnson	Prin. Res. Sci.	Chief Palace	14-15 Jan. 08	WHO/ UGMS
Stakeholders meeting on draft guidelines for advertisement of alcoholic beverages	Dr. W.A Plahar	Director	FDB Head Office	20th March, 2008	FDB
2-day ICM Policy development "write-up"	Dr. L. D Abbey Mr. K. Bugyei	Res. Sci ASIO	Shai Hills Beach Resort	10th -11th March, 2008	CSIR-INSTI
Stakeholders workshop on W/A Agric. Productivity program	Dr. Johnson	Prin. Res. Sci.	CSIR-CRI Conference Room	17th – 18th April, 2008	CSIR-AFFS.
CTA/INSTI/MISTOWA stakeholders seminar	Dr. Johnson	Prin. Res. Sci	Shai Hills Beach Resort	19th – 20th May, 2008	CTA/INSTI/ MISTOWA
Focus group meeting, CTA Products and services	Dr. C. Tortoe	Res. Sci.	INSTI	28th May, 2008	INSTI
CTA/INSTI Regional workshop	Dr. W.A Plahar	Director	INSTI	9th – 13th June, 2008	CTA/INSTI

Roundtable discussion on competence and technology for safer foods and increase agricultural export	Dr. K. Kpodo	Snr. Res. Sci.	Golden Tulip Hotel	18th June, 2008	PTB/GSB/ FRI
Technical working groups-cross sectoral planning group	Dr. PNT Johnson	Prin. Res. Sci.	Nat. Insurance Commission conference hall	22nd July, 08	NDPC
3-day consultative meeting	Dr. PNT Johnson Dr. L.D Abbey	Prin. Res. Sci Snr. Res. Sci	Alexis Hotel, Afienya	4th – 6th August, 2008	CSIR-INSTI
2-day workshop on marketing agric information services	Mr. Kwabena Bugyei	ASIO	CSIR-FORIG	18th – 19th August, 2008	CSIR-FORIG
3-days website dev't and management workshop	Mr. Stephen Nketia Mr. Kwabena Bugyei	Scientific Sec. ASIO		17th – 19th Sept. 2008	
PACF ECOWAS Regional Meeting	Dr. PNT Johnson	Prin. Res. Sci.	CSIR-STEPRI	26th Sept. 08	CSIR-STEPRI
National Workshop to validate the fisheries and aquaculture policy document			Alisa Hotel	27th Nov. 2008	
workshop on principles of quality assurance in testing laboratories	Mr. William Amevor Mr. David Baisel Mr. Evans Agbemefle		Hotel Majory-y	14th June, 2008	Ghana Institute for Pure & Appkied Chemistry

APPENDIX IV

CSIR – FOOD RESEARCH INSTITUTE COMMERCIAL ACCOUNTS FOR YEAR ENDING 31ST DECEMBER 2008

	DIVISION/UNITS	ACTUAL INCOME FOR THE YEAR	ACTUAL EXPENSES FOR THE YEAR	NET INCOME FOR THE YEAR	BALANCE AS AT 1/1/2008	BALANCE AS AT 31/1/2008
A	**MICROBIOLOGY**					
	LAB. ANALYSIS	123,687.37	29,227.80	94.459.57	43,063.74	137,523.31
	MUSHROOM UNIT	12,058.13	13.722.47	(1,664.34)	2,626.74	962.40
	SUB TOTAL	**135,745.50**	**42,950.27**	**92,795.23**	**45,690.48**	**138,485.71**
	RATE OF SUB TOTAL TO TOTAL	**0.48**	**0.21**	**1.21**		
B	**CHEMISTRY**					
	GEN. CHEMISTRY	28,810.75	23,538.46	5,272.29	4,542.65	9,814.94
	AFLATOXIN	16,957.40	2,683.48	14,273.92	10,220.68	24,494.60
	SUB TOTAL	**45,768.15**	**26,221.94**	**19,546.21**	**14,763.33**	**34,309.54**
	RATE OF SUB TOTAL TO TOTAL	**0.16**	**0.13**	**0.25**		
C	**PROCESSING & ENGINEERING**					
	PILOT SCALE PRODUCTION UNIT	20,956.27	13,354.77	7,601.50	2,370.62	9,972.12
	ENGINEERING UNIT	46,696.97	34,297.48	12,399.49	340.97	12,740.46
	ROOT & TUBER PROD. & DEV. UNIT	21,482.00	14,342.00	7,140.00	1,981.00	9,121.00
	SUB TOTAL	**89,135.24**	**61,994.25**	**27,140.99**	**4,692.59**	**31,833.58**

	RATE OF SUB TOTAL TO TOTAL	**0.32**	**0.30**	0.35		
	OTHERS					
D	FOOD & SOCIO-ECONOMICS	528.00	3,383.47	(2,855.47)	667.56	(2,187.91)
	MORINGA TRAINING	1,231.00	252.38	978.62	1,039.35	2,017.97
	INFORMATION & FRI SHOP	5,747.30	7,526.00	(1,778.70)	(403.70)	(2,182.40)
	OTHERS INSTITUTIONAL ACTIVITIES	4,362.76	63,384.11	(29,021.35)		(59,021.35)
	SUB TOTAL	**11,869.06**	**74,545.96**	**(62,676.90)**	**1,303.21**	**(61.373.69)**
	RATE OF SUB TOTAL TO TOTAL	**0.04**	**0.36**	**(0.82)**		
	GRAND TOTAL	**282,517.95**	**205,712.42**	**76,805.53**	**66,449.61**	**143,255.14**
	RATE OF NET INCOME TO GRAND INCOME			**0.27**		
			Year ending 2007	Summary of Activities Year ending 2008	% Increase	
	TOTAL REVENUE		172,891.97	282,517.95	0.63	
	TOTAL EXPENSES		160,279.00	205,712.42	0.28	
	NET INCOME		12,612.97	76,805.53	5.09	

APPENDIX V

CSIR-FRI STAFF WHO COMPLETED TRAINING

No	Name	Institution
1.	Mr. Eric Ofori	BA, IPS
2.	Mr. Charles Diako	MPhil, University of Ghana
3.	Mrs. Linda Hagan	MPhil, University of Ghana
4.	Ms. Matilda Dzomeku	MPhil, KNUST
5.	Ms. Bernice Kudjawu	MSc, Perdue University/University of Ghana

CSIR-FRI STAFF UNDER TRAINING

No	Name	Institution
1	Mrs. Ivy Yawson	MSc. Univ. of Minnesota/Univ. of Ghana
2.	Ms. Margaret Owusu	PhD University of Denmark
3.	Mr. Kofi Kweghir Essel	Bsc UDS
4.	Ms. Joana Dzikunu	BA , IPS
5.	Mr. Appolonius Nyarko	BSc, UCC
6.	Mr. Emmanuel Alorsey	BSc , KNUST
7.	Ms. Mercy Fianu	BSc , UCC

APPENDIX VI

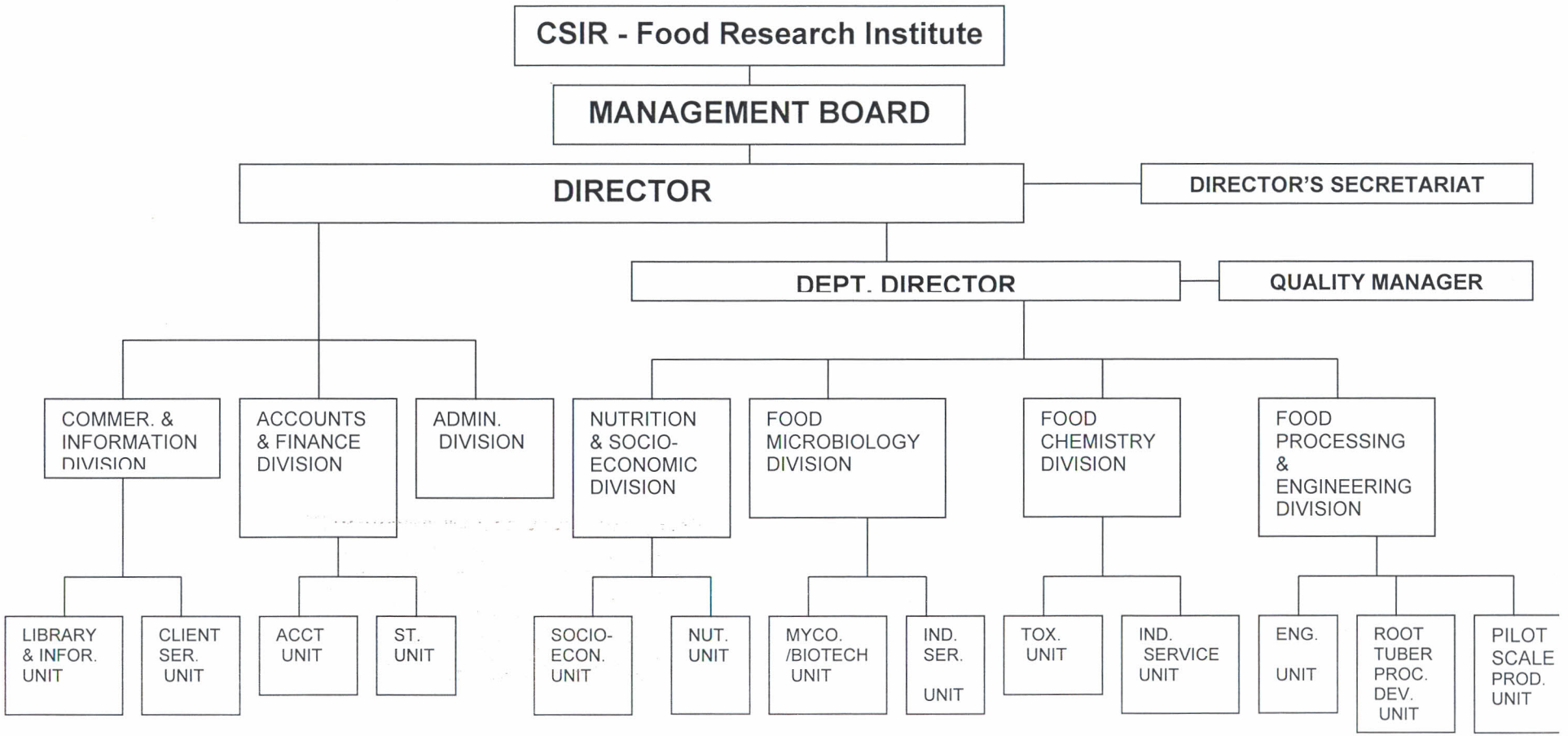
CSIR-FRI STAFF PROMOTIONS

No	Name	Grade Promoted To	Effective Date
1.	Mr. Rhodes Anthonio	Chief Works Supt.	1st January 2008
2.	Mr. Godwin Aklieh	Chief Works Supt.	1st January 2008
3	Mrs. Victoria Alambire-Asunka	Snr. Admin Asst.	"
4	Mrs. Buella Sallah	Snr. Admin. Asst.	"
5	Mr. Kofi Kwegyir Essel	Technologist	"
6	Mr Appolonius Nyarko	Technologist	"
7.	Mr. Christian Amega	Principal Accounting Asst.	"
8	Mr. Eric Ofori	Snr. Admin Asst.	"

9.	Mr. Jeremiah Lartey Brown	Snr. Technical Officer	"
10.	Mr. Emmanuel Allorsey	Snr. Technical Officer	"
11.	Mr. Ben Adu	Asst. Transport Officer	"
12.	Mr. James Cromwell	Stores Supt.	"
13.	Mr. Emmanuel Agyei Ammon	Junior Foreman	"
14.	Mr. Sampson Tawiah	Junior Foreman	"
15.	Mr. Joseph Abbey	Snr. Tech. Asst.	"
16.	Mr. Derrick Ashley	Snr. Tech. Asst.	"

APPENDIX VII

ORGANOGRAM



COMMER-COMMERCIALIZATION **ADMIN**-ADMINISTRATION **INFOR**- INFORMATION **SER**- SERVICE **ACCT**- ACCOUNTS **ST**.-STORES **ECON**- ECONOMICS
NUT-NUTRITION **MYCO**-MYCOLOGY **BIOTECH**- BIOTECHNOLOGY **IND**-INDUSTRIAL **TOX**- TOXICOLOGY **ENG**-ENGINEERING **PROC**-PROCESSING
DEV-DEVELOPMENT **PROD**-RODUCTION